PUBLISHED BY THE INSTITUTE OF FOOD TECHNOLOGISTS

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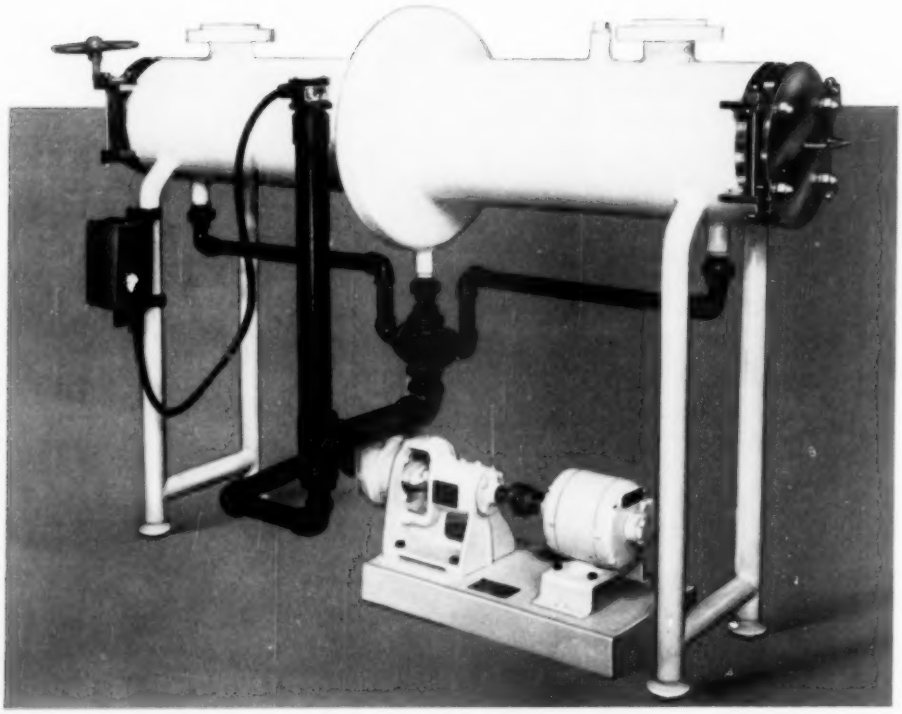

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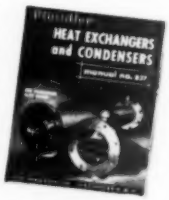

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Published Monthly by the Institute of Food Technologists

Volume 7 **October 1953** **Number 10**

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Address to this office all manuscripts, proofs, letters pertaining thereto, etc. Prospective contributors are invited to send for the pamphlet *Information and Suggestions to Authors* which contains style instructions.

Responsibility for statements appearing in FOOD TECHNOLOGY rests on the author thereof; points of view expressed in the columns of the journal do not necessarily have the indorsement of the Institute of Food Technologists.

Office of the Business Manager

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Address to the business office all requests for subscriptions, changes of address, and information on advertising. Claims for copies lost in the mails must be received 30 days after issue (90 days, foreign). Changes of address must be received at least two weeks before date of issue.

Subscription Rates: For members the cost of subscription is included in the annual dues. Non-members: domestic, $7.50 per year; foreign, $8.50 per year. Single and back copies: domestic, $1.00; foreign, $1.15.

Advertising Representatives: *Eastern:* Duncan Macpherson, 700 S. Washington Square, Philadelphia 6, Pa. *Midwestern:* Prendergast and Minahan, 168 N. Michigan Avenue, Chicago 1. *West Coast:* Duana Wanamaker, 610 S. Broadway, Los Angeles 14, California.

Publication Office

The Garrard Press, 119 West Park Avenue, Champaign, Illinois

Address to the Publication Office all requests for non-member subscriptions, back volumes, single copies (costs are listed above). Authors desiring reprints should address orders to this office; rates are printed on the order blank. (Requests for a single reprint of a published paper should be addressed to the author.)

FOOD TECHNOLOGY is published by the Institute of Food Technologists and printed by the Garrard Press, Champaign, Illinois, U. S. A.

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Mailing Permit: Entered as second-class matter, Feb. 25, 1947, at the Post Office at Champaign, Illinois, under the Act of August 24, 1912.

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Affairs of the Institute

Progress and Responsibilities in the Food Industry
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Regional Section News
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With this issue we initiate a series of editorials prepared by distinguished practitioners of the profession of food research and technology. The October editorial was contributed by Dr. Charles N. Frey—whose most recent honor was the Babcock Award, conferred in Boston at the Annual Meeting. His editorial furnishes a fine overture to the October issue, which features the papers presented at the session on chemical additives, June 23, 1953, Thirteenth Annual Meeting of the Institute of Food Technologists.

Progress and Responsibilities in the Food Industry

The food industry is passing through a period of evolution that involves basic changes and developments. Transformations are proceeding at a rapid rate, governed and tempered by the vigorous and revolutionary advances in the physical, chemical, engineering, and biological sciences. Age old processes in every industry as well as in recently developed processes in the test tube industries are being given searching investigations. They must meet the measure of the new scientific discoveries as well as the laws of economic change. One is reminded of the lines of Ariel in Shakespeare's "The Tempest":

"But doth suffer a sea-change
Into something rich and strange"

The tempo of our days is, indeed, breath taking. New products and new procedures follow day after day, and the consumer finds this stimulating barrage exciting and interesting, especially if the new products are beyond his imagination to have foreseen. He has faith in the great organizations that are utilizing science so effectively in supplying his needs, desires and convenience. However, industry may have been too complacent in its efforts to inform and educate the public, the medical man, and the government officials who have the responsibility of protecting the food supply and the health of the people.

So vast is the impact of the fundamental sciences that experts in various areas are aware of the necessity for continual orientation. The technologist is equally pressed by the mass of information he must digest if his particular industry or product is to meet the standards set by his competitors. And further he feels that if a fundamental scientific discovery applicable to his problems is not used, he is not performing his function. The race is to the strong and well prepared, to those who have knowledge of the equipment, the materials and the information that is available in other sciences and industries. We have by no means reached a point where technology has exhausted all the stores of scientific knowledge or always kept pace with pure science, but in many fields lack of fundamental science is holding back technology.

Thus it becomes a matter of great concern to the food technologist to maintain or to accelerate his research program, to effect better relations with the consumer, government agencies, and medical scientists in respect to the changes and advances in his field. He must carry his ever changing technology to the market place and tell of his progress, his new conceptions, his new products, and he must fortify his statements by means of sound experimental data. This education begins by disclosures and the contribution of scientific papers at scientific meetings, but it should also be carried on stage by stage until it reaches the man in the street and the consumer in his home.

Progress is being made in this area. At the recent meeting of the IFT in Boston, sorbic acid was formally presented to the public. Its use, function, chemical structure, reaction in foods, the pharmacological and nutritional studies involved, the procedure used in testing the product, methods of analysis, its evaluation as health hazard, if any, were ably presented for all to discuss and criticize.

In another section at the annual meeting of the IFT a group of outstanding scientists were engaged in presenting a series of papers on the various aspects of the use of chemicals in foods. The reactions of various professional groups toward the use of chemicals in modern food processing were discussed. Education of this nature will encourage industry to extend even further its efforts to meet every phase of the health aspects involved in the newer techniques where chemicals are employed in procedures inherent in modern food processing. The food and chemical industries have not neglected this approach. They have followed carefully the nutritional and pharmacological behavior of the chemicals introduced into foods and in many cases have freely disseminated the resulting information.

As food technologists we realize the need of extending our knowledge of the reactions involved when chemicals are introduced into foods. The chemist is not always able to predict the type of reactions which may take place when a new chemcial is employed, or to exactly duplicate in a laboratory process an organic chemical compound found in nature. In many instances he can do so, but even chemical compounds or food produced by a procedure long in use may, according to one view, require an organized study based on the nutritional use of the product in a controlled experimental environment. Dr. Sevringhaus stated, "Substances consumed as food for centuries are not necessarily harmless since millions of people have died of unknown causes during that period." However, our health record is good, and mortality tables indicate that the span of life is increasing. Many people live to a great age. Consequently, it may not be necessary to be too deeply concerned about this aspect of the problem, but we should be alert for any signs that indicate a hazard is involved. Mere use of a food for long periods of time is not an indication that a substance or a food is harmless. Many of the chemical additives recently

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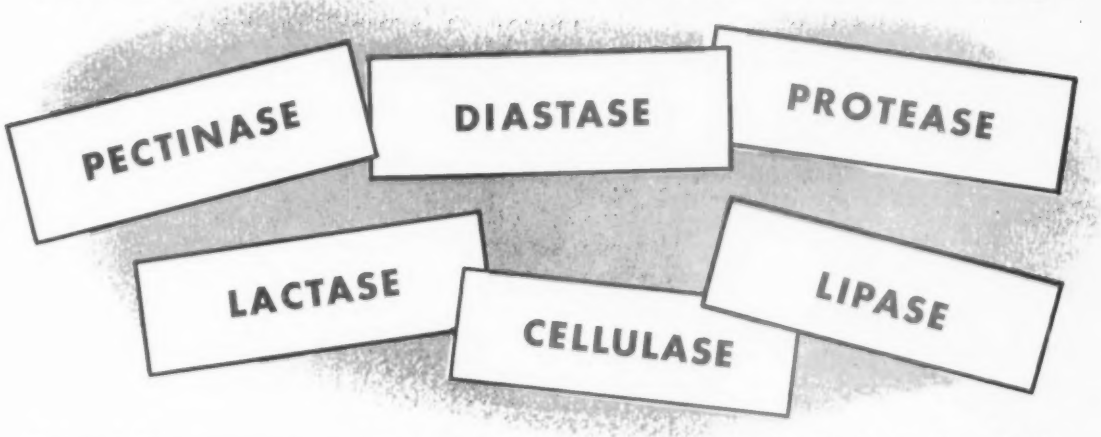

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PROGRESS AND RESPONSIBILITIES IN THE FOOD INDUSTRY

(Continued from page 4)

applied in food processing are better known pharmacologically than are some of the chemicals used in processing or produced in processed foods long in use.

The suggestion made by Dr. D. B. Hand, similar in some respects to ideas discussed during the formation of the Food Protection Committee, that industry establish an Institute to support research and to cooperate with the Food Protection Committee in order to insure the continuation of technological progress, indicates the broad interest in this fundamental and important area.

It has frequently been suggested that the IFT establish a committee to pass on legislative matters pertaining to the use of chemicals in foods. Many of the matters connected with these problems involve management decisions. It is not within the province of the Committee on Chemicals in Foods as presently constituted to decide on matters of policy. Its object has been educational and informative. It would seem to be appropriate for industrial organizations to support technical committees representing management to cover matters of policy involving technical problems.

Doctors G. R. Cowgill and W. A. Krehl question "the wisdom of combining judicial, legislative and executive functions in a single agency of government." This situation is, indeed, complex, and further study should be given to it inasmuch as industry is vitally concerned in respect to its relations with the Food and Drug Administration. These relations have been excellent during the past. Possibly the present system with changes, such as removal of scientific findings from the standards hearings; simplification of standards hearings procedures; working out more effective regulations for labeling of food products, preferably putting less reliance on standardizing products; declaration by the manufacturer of the proposed use of a chemical prior to marketing; and finally, a more precise definition of the legal meaning of the term "poisonous and deleterious substances;" is as workable and satisfactory as can be devised. There should be opportunity for frank discussion between the chemists of the Food and Drug Administration and those of industry. This also applies to the executives of both groups. It is in the interest of the public that industry and the Food and Drug Administration maintain sound and helpful relations, and that both cooperate in the education and in the protection of the public.

Doctors Cowgill and Krehl also advocated the establishment of a National Foundation of food technology supported by the food and chemical industries. The Foundation would operate as a separate and impartial organization with a scientific director and a governing board from industry, universities, public organizations and government. It should develop scientific information and should contribute to the education of the public. This is a very comprehensive program and would cover some of the suggestions included in Dr. Hand's proposals. However, there are a number of excellent institutions with organized courses in food technology. Several devote a great part of their efforts to fundamental investigations in this field. Perhaps greater interest on the part of industry and government in supplying funds to carry on a broad program of fundamental work in existing institutions might accomplish some of the purposes Doctors Cowgill and Krehl have in mind.

The address of Dr. Sebrell of the National Institutes of Health at the IFT meeting in Boston indicates the need for further research in the field of food and nutrition: "Far from reaching the point of diminishing returns, nutrition research today is confronted by a whole galaxy of highly complex, interrelated problems, the full significance of which is not yet adequately understood and appreciated. Clearly, they will require much fundamental research and long-term support by public, private, and industrial organizations."

It is evident from the papers I have quoted that the food industry must be progressive in its research and manufacturing operations. It must assume its responsibilities with vision and in a spirit of cooperation in order to fulfill its obligations to the public.

CHARLES N. FREY.

Annual Meeting Bulletin Board

IT'S LOS ANGELES IN 1954!

From jackrabbit land to third largest metropolitan area in 100 years is the record of Los Angeles, miracle city of the West, site of the 1954 annual meeting of the Institute of Food Technologists, June 27 through July 1.

To describe Los Angeles, it is necessary to talk about more varieties of topography, scenery, people, and business than it is for any other city. Actually, within their borders the city and county of Los Angeles cover

SAN FERNANDO MISSION, founded September 8, 1797. A view of the courtyard and the statue of Father Junipero Serra, founder of the California missions.

a greater variety of scene than that of many states. Los Angeles county is a place where scenery and topography run from arid, sandy desert to lush gardens and orchards, to pinestudded mountains, to cool, surf-washed beaches. Los Angeles, the city, is cosmopolitan, its atmosphere of Spain blending with a touch of the Orient, a whiff of Paris, and a dash of the Golden West.

Commercially and economically, Los Angeles is as kaleidoscopic as it is in terrain and people. It ranks as center of fashion design, airplane building, petroleum a national leader in manufacturing of all sorts. It is a production, steel-making, automobile assembly, gift-

(Continued on page 8)

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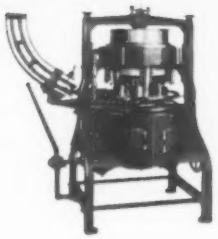

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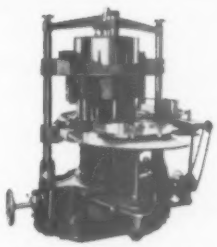

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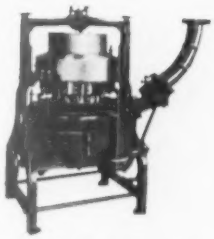

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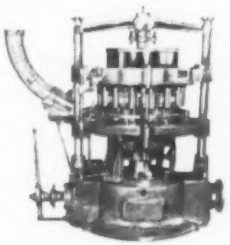

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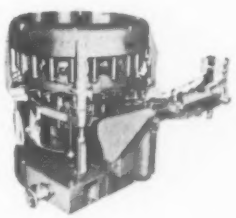

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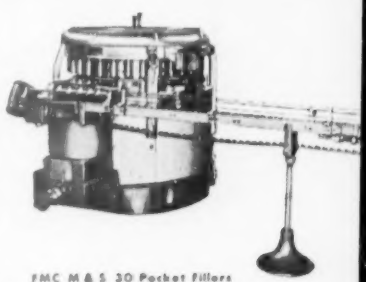

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(Continued from page 6)

ware designing, rubber working, distribution center for many foods and beverages and countless other products. The value added to products in manufacturing processes is now some three billion dollars a year.

Only a century ago, Los Angeles was a wilderness town of 1600. Now the city population is nearly 2,050,000, the county population exceeds 4,466,000, and the population of the metropolitan area is 4,717,470. Pace of construction is one of the big Los Angeles stories. The county nailed up a record of $1,033,430,853 in building permits in 1950, topping 1949 by more than $300,000,000. And 1952 and 1948 were the second and third best years on record with more than $930,000,000 and $859,778,000, respectively. Bank debits in 1952 totaled $50,323,490,000, compared to $9,780,000,000 in 1937. Postal receipts leaped from $12,925,000 in 1938 to $43,908,408 in 1952.

WORLD FAMOUS WILSHIRE BOULEVARD. Crossing MacArthur Park with downtown Los Angeles in the background.

Other millions of dollars are being poured into industrial establishments, ranging from small ceramics plants to giant automobile factories and aircraft plants. Industrial development has defied predictions of the best experts. During the war, when military production brought $232,190,000 in industrial investments, businessmen shook their heads and said that there would be a sharp dropoff when peace came. Instead, factory development continued to soar, passing all previous records. Since VJ Day, manufacturing investments—in new and expanded plants—total $1,008,675,000. The predicted slump turned out to be a great increase, in dollar value. In number of new plants, the postwar gain has been 1,244 compared with some 500 for the wartime era.

Another development of recent years has been the increased number of national firms selecting Los Angeles as the site of western branch plants, according to the Chamber's industrial development committee.

Who is moving to Los Angeles? Here are just a few: Union Carbon and Chemical Co.; Anheuser-Busch; Schlitz; Libbey Glass; Lever Bros.; Standard Steel Spring; Warner-Hudnut; Ecko Products; Borden Co.; Koolvent Metal Awning Co.; Cloroz Chemical Co.; American Brass Co.; National Container; E. R. Squibb and Sons; and Duell Paint Co. Among those who have moved west already are Carnation Milk, Rexall Drug, Prudential Life Insurance Co. and many smaller firms.

Agriculture is another record-breaking economic factor in Los Angeles county. The grand total of 1951 farm products, including livestock, was approximately $242,822,000. The bureau of census has listed Los Angeles as one of the highest-income agriculture counties in the country since 1910. Nearly 199,450 acres are under cultivation. They produce a score of crops worth more than $1,000,000 apiece annually.

Of economic significance also is the great recent growth of retailing. Numerous major independent department stores and several chains have built or announced plans for more than a dozen large stores in suburban communities. These, with hundreds of supermarkets, drug stores, and lesser retail units, have helped provide hundreds of thousands of new jobs.

Los Angeles is a giant, still growing. Leaders in the community are giving careful guidance to the development of the city to keep the necessary elements of greatness in economic balance. Diversity of commercial endeavor, diversity of human factors, diversity of scenery, and diversity of recreational facilities will provide for IFT members, concentrated on the serious business of food research and technology, a dividend over and above the professional profit of the meetings—a diversity of travel experience.

Food technologists are reminded that abstracts of papers are due in the hands of the General Program Chairman or of the symposia leaders by February 1, 1954. The full list appears in the September, 1953, issue of FOOD TECHNOLOGY, but is recapitulated here in abbreviated form, as follows:

General Papers: DR. ARTHUR N. PRATER, Gentry Div., Consolidated Grocers, Los Angeles.

Fruit and Vegetables Research: JOHN H. MACGILLIVRAY, Univ. of California, Davis.

Flavor Changes as Influenced by Applied Chemicals: CHARLES H. MAHONEY, National Canners Assoc., 1133 20th Street, N. W., Washington 6, D. C.

Food and Drug Standards: CHARLES W. KAUFMAN, Kraft Foods, 500 Peshtigo Court, Chicago 90.

Citrus Concentrates: W. R. ROY, Minute Maid Corp., Plymouth, Fla.

Basic Investigations in Food Science: AKSEL G. OLSEN, General Foods Corp., 11th and Hudson, Hoboken, N. J.

Consumer Testing: HELEN L. HANSON, Western Regional Research Laboratory, Albany 6, Calif.

Marketing Problems: ROY H. WALTERS, General Foods Corp., 250 Park Avenue, New York City.

Special Purpose Foods: ERNEST GEIGER, 3842 Monteith Drive, Los Angeles 43.

Seafood and Seafood Products: KARL ENVOLDSEN, Envoldsen Shrimp, Inc., 1200 West 9th St., Cleveland 13.

Wine and Wine-tasting: HAROLD W. BERG, Univ. of California, Davis.

Food Engineering: CURTIS E. MAIER, Continental Can Co., Inc., 4645 West Grand Ave., Chicago 39.

What's New in Food Packaging: KENNETH W. BRIGHTON, American Can Co., Maywood, Ill.

Pectin and Pectic Materials in Food Processing and Preservation: REESE H. VAUGHN, Univ. of California, Davis.

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Regional Section News

WESTERN NEW YORK SECTION

Members of this Section were the guests of the Pleasant Valley Wine Company at Hammondsport, N. Y., on August 29th. Trips were made through the plant in the forenoon and, following luncheon at the plant, many drove over to Corning to see the Corning Glass exhibit in the afternoon.

The Fall Meeting is to be held on September 18th at the General Brock Hotel, Niagara Falls, Ont., Canada.

DIXIE SECTION

The Dixie Section held its Summer Meeting August 7, the first since the new officers of the year assumed their duties, at the University of Tennessee in the form of a picnic and steak supper. The formal meeting was at the new Food Processing Building, University of Tennessee after a tour of the laboratories and facilities for processing fruits, vegetables, meats, and poultry.

Dr. J. W. Cole, Assistant Professor of the Department of Animal Husbandry gave an illustrative lecture on grading and cutting pork, beef, and lamb. In addition to actually using carcasses for illustration, he showed two film strips on proper methods of cooking meats.

The picnic was held at Tyson Park in the City of Knoxville, at which Dr. Cole personally cooked and served as many steaks as those in attendance could eat. Also on the menu were ice cream and Tennesee frozen strawberries.

BRITISH COLUMBIA SECTION

Activities of the British Columbia *Food Technologists Club* during 1953 are reported as follows:

February 11, 1953

Speaker: Mr. T. E. Atkinson. Dominion Experimental Station, Summerland.

Topic: "The Canadian Fruit and Vegetable Processing Industry."

March 18, 1953

Speaker: Mr. L. Farber, George Hooper Foundation, University of California, Berkeley, California.

Topic: "Methods for Determination of Spoilage in Food Products."

April 19, 1953

Speaker: Mr. A. L. Aughi, Food Technologist, Hazel-Atlas Glass Co., San Francisco, Calif.

Topic: "Glass Container Manufacture and Use of Glass as a Food Package."

April 29, 1953

Election of Officers for B. C. Section No. 22. The list of officers elected are as follows:

Chairman: P. A. Sunderland, B. C. Packers, Vancouver, B. C.
Secretary: W. D. Sargent, A. Ingre Ltd., Vancouver, B. C.
Councillor: C. E. Strachan, Dominion Experimental Station, Summerland, B. C.

May 13, 1953—Fifth Annual Banquet of B. C. Food Technologists

The Fifth Annual Banquet of the B. C. Food Technologists was held at Stanley Park Pavilion with an attendance of about 115 persons. This year it included wives and friends of the members.

The banquet chairman was Mr. Douglas Dougans, who deserves most of the credit for the splendid manner in which the arrangements were carried out. Twenty or more door prizes consisting of various food items were given out. These and the cocktails were donated by local companies.

Mr. Dougans introduced the M. C. for this occasion, Professor G. C. Andrews of the University of British Columbia.

Invited guests included Mr. Douglas M. Stewart, representing the meat packing industry; Mr. John Macdonald, representing the fishing industry; and Mr. George Okulitch, representing the dairy industry.

The guest speaker was Mr. Fred Mather, who is one of the leaders in the B. C. food processing industry. He emphasized the fact that the food technologist deserves a lot of credit for the wonderful food in the world today. Mr. Mather's remarks were all very much appreciated by the group.

Mr. Gyan Boothby, the retiring chairman, spoke on the activities of the group during the year and expressed his opinion that the group was gaining in strength. He closed his remarks by introducing the incoming officers.

Selected Abstracts*

ANALYTICAL METHODS

Determination of gelatin in meat extract and meat stocks—interim report.

Analytical Methods Committee. *Analyst, 78,* 134-5 (1953).

The method depends on formation of a gelatin-formaldehyde complex. Nitrogen in the complex is detd. by Kjeldahl. Gelatin is calcd. with the usual factor.

Connective tissue of meat. II. Determination of hydroxyproline.

Baker, L. C., Lampitt, L. H., and Brown, K. P. *J. Sci. Food Agr., 4,* 165-72 (1953).

The density of color produced in Neuman and Logan's method for the estn. of hydroxyproline was measured in a Hilger Spekker absorptiometer. On any one occasion satisfactory duplication was obtained with aliquots of the same soln. of hydroxyproline, and a smooth curve resulted when concn. was plotted against color density. However, from time to time the level of the curve fluctuated slightly, and therefore the color should be developed in standard solns. when any 'unknowns' are being estd.

The chemistry of vegetable tannins. VII. Acetyl values.

Putnam, R. C., and Bowles, A. V. *J. Am. Leather Chemists' Assoc., 48,* 241-7 (1953).

Acetyl values of three purified tannins and their derivs. were obtained by different methods and the data compared. Analysis of the results in the light of infra-spectrograms of the residues from the acetyl detns. in conjunction with a consideration of past literature on the subject indicated that alk. hydrolysis gives the most dependable values.

Identification of leuco-anthocyanins as "tannins" in foods.

Bate-Smith, E. C., and Swain, T. *Chem. & Ind.,* 377-8 (1953).

Evidence is presented to show that leuco-anthocyanins are closely related chemically to the catechins and should be regarded as prototypes of the condensed tannins.

* These Selected Abstracts are made available to Food Technology through the cooperation of Associate Editor H. A. Campbell and the General Foods Corporation of New York, N. Y. The abbreviations found in these abstracts are similar to those used by Chemical Abstracts.

(Continued on page 14)

Time to double check VANILLA *Quality*

Many manufacturers today are revising their vanilla flavor formulations, and this is the time to put the stress on quality — make a change for the better. The trend is back to real vanilla taste and the standard Alva vanillas have been doing just this job for years.

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SELECTED ABSTRACTS

(Continued from page 10)

Identification of cumaric acid in rough rice.

MUNSEY, V. E., AND GRAICHEN, C. *J. Assoc. Offic. Agr. Chemists, 35,* 928 (1952); *Chem. Abstr., 47,* 4514e (1953).

Cumaric acid was found in 3 varieties of rough rice, Rexaro, Blue Bonnet, and Pearl, and a probably related compd. was found in the Zenith variety. The cumaric acid was identified by its ultraviolet absorption spectrum and by the AOAC coumarin test.

Determination of the terminal carboxyl residues of peptides and of proteins.

BAPTIST, V. H., AND BULL, H. B. *J. Am. Chem. Soc., 75,* 1727-9 (1953).

A new method involves the creation of the thiohydantoin on the carboxyl end of the peptide chain in an acid medium, the amino end being blocked by acetylation. The thiohydantoin is then hydrolyzed from the peptide in an acid medium and isolated. The purified thiohydantoin is then hydrolyzed in an alk. medium, thus producing the corresponding amino acid which is then identified and estd.

The thiobarbituric acid test for butterfat oxidation.

BIGGS, D. A., AND BRYANT, L. R. *Can. J. Technol., 31,* 138-45 (1953).

Time of reaction, pH of reaction mixt., presence of oxygen in the reaction chamber, and presence of an emulsifying agent in the reaction mixt. are shown to influence the amt. of color produced. The modified method can be applied to the detn. of oxidation in powd. whole milk, Cheddar cheese, and butter. Duplicate detns. on these products indicated good reproducibility. The results on milk powders showed a correlation between test values and organoleptic flavor scores and indicated that the test is capable of measuring degrees of oxidation below the level of organoleptic sensitivity.

The qualitative determination of higher fatty acids by means of string electrophoresis.

BARNETT, A. J. G., LEES, H., AND SMITH, D. K. *Biochem. J., 53,* xxxiii, March, 1953.

A technic for the identification of higher mol. wt. fatty acids using electrophoresis on candle wick thread is described.

Pesticide residues. Basic principles for quantitative determination.

GUNTHER, F. A., AND BLINN, R. C. *J. Agr. Food Chem., 1,* 325-30 (1953).

The basic analytical approaches to residue detns. are considered to be evaluation by direct measurement (selective) and isolation followed by measurement (non-selective). The latter approach interrelates phys. sepn. with reaction sepn. These logical approaches to devising analytical methods for pesticide residues are illustrated from the field of insecticides. Even though every foodstuff contg. pesticide residues must be individually investigated as to performance in the final residue method, there is real promise of systematization and standardization of efforts in new applications.

BIOLOGICAL SCIENCES

BIOCHEMISTRY

Labeling of specific glucose carbons formed from succinic acid-1-C^{14} and -2-C^{14} in the diabetic dog.

ABRAHAM, S., AND CHAIKOFF, I. L. *Arch. Biochem. Biophys., 41,* 143-7 (1952).

Samples of urinary glucose obtained from diabetic dogs that had been injected with succinic acid-1-C^{14} and succinic acid-2-C^{14} were degraded, and the C^{14} content of individual glucose carbons was detd. In the expt. with succinic acid-1-C^{14}, C^{14} activity was found in only the two middle carbons of the urinary glucose. When succinic acid-2-C^{14} was injected, 80% of the C^{14} found in the glucose molecule resided in carbons 1, 2, 5, and 6. These labeling patterns are discussed in connection with the conversion of palmitic acid to glucose.

Short-term carbon dioxide fixation in mouse liver.

LEEPER, L. C., FRIEDBERG, F., AND MARSHALL, L. M. *Nature, 171,* 748-9 (1953).

$NaHC^{14}O_3$ was injected into mice and animals were sacrificed 3 min. later. The livers were removed. Radioactive spots were located by placing x-ray film over paper chromatograms of liver homogenates. Identification of the spots was by chem. test or by the partition coeff. of the unknown between 0.1*N* HCl and ether. No labelling of fumaric, aconitic or α-ketoglutaric acid was detected. The most active compds. formed were glucose, urea, succinate, oxalacetate and malate.

Metabolism of C^{14}-ethanol by surviving rat tissues.

MASORO, E. J., ABRAMOVITCH, H., AND BIRCHARD, J. R. *Am. J. Physiol., 173,* 37-40 (1953).

The ability of various rat tissues, *in vitro,* to oxidize C^{14}-labeled EtOH to CO_2 and H_2O and to convert it to lipids was investigated. The rate of oxidation by liver tissue is affected by the concn. when the surrounding medium is below 60 mg. %; from this concn. to one of 250 mg. %, the rate of oxidation is const. The relation of this finding to the possible involvement of more than one enzyme system is discussed. Of the tissues studied, the kidney has the greatest ability to oxidize EtOH to CO_2 and H_2O, but the liver exceeds the kidney in its ability to convert EtOH to lipids. The lung can convert EtOH both to CO_2 and to fatty acids. The diaphragm was able to oxidize EtOH only very slightly, and was totally unable to convert it to lipids. The brain showed no ability to metabolize EtOH.

Hydrolysis of proteins by ion exchange resin catalysis.

PAULSON, J. C., DEATHERAGE, F. E., AND ALMY, E. F. *J. Am. Chem. Soc., 75,* 2039-41 (1953).

The hydrolysis of casein by ion exchange resin catalysis proceeds very near to the point of completion after refluxing the protein with 0.05 *N* HCl and Dowex 50 for a period of 48 hrs. Low recoveries of certain amino acids are believed to be due to the presence of unhydrolyzed peptide residues. The rate of protein hydrolysis by ion exchange resin catalysis is affected by the nature of the resin and the nature of the protein. Among the proteins investigated, this type of hydrolysis indicates a peptide bond selectivity for certain amino acids.

Ascorbic acid and the formation of collagen.

ROBERTSON, W. VAN B., AND SCHWARTZ, B. *J. Biol. Chem., 201,* 689-96 (1953).

After the abdominal subcutaneous injection of Irish moss ext. in guinea pigs it was found that ascorbic acid was needed for collagen formation in the tissue. Attempts to demonstrate a precollagen from ascorbic acid-deficient guinea pigs were unsuccessful but, if a precollagen is present, it was postulated that it is low in hydroxyproline.

Fractionation of an enzyme by foaming.

LONDON, M., COHEN, M., AND HUDSON, P. B. *J. Am. Chem. Soc., 75,* 1746-7 (1953).

Jackbean urease was purified by foaming off inactive protein. The effect of various conditions on the concn. of the urease in the foam was detd. The ratio of urease/total nitrogen is defined as the "purity no." The ratio of purity no. of fraction/purity no. of original material was defined as "purification."

Phosphorylated hesperidin.

MARTIN, G. J. *Science, 117,* 363 (1953).

Apparently, the antifertility effect of phosphorylated hesperidin is a function of one component of a mixt. of different phosphates.

BOTANY

Biosynthesis of C^{14}-specifically labeled cotton cellulose.

GREATHOUSE, G. A. *Science, 117,* 553-4 (1953).

Glucose 1-C^{14} was introduced through the sliced stem of a 21 day boll. After maturing, the cellulose was recovered, and 44% of the active C^{14} introduced was found in cellulose. All the activity stayed in the 1 position of the glucose. This was proved by oxidizing the glucose with O_2 in KOH soln. and detg. activity of the K-d-arabonate formed. Thus glucose is synthesized directly to cellulose by the enzyme system of the cotton boll.

(Continued on page 16)

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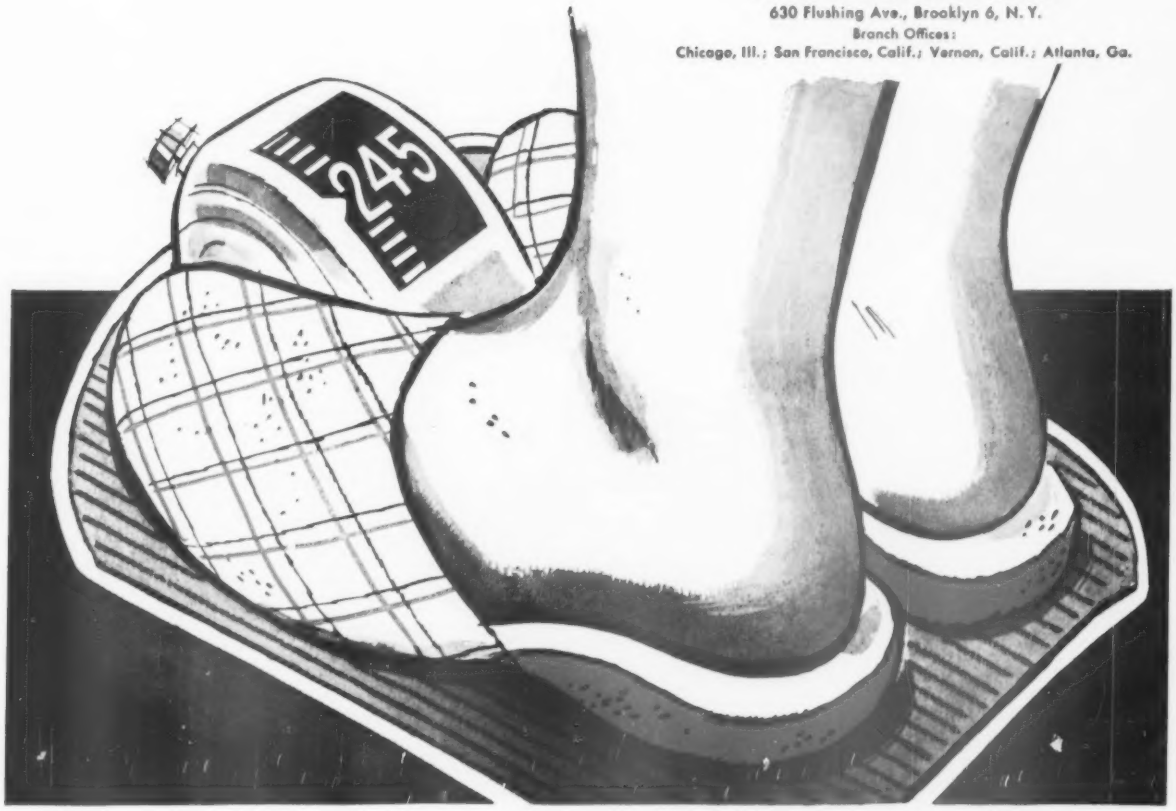

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SELECTED ABSTRACTS

(Continued from page 14)

High temperature plant.

Science News Letter, 63, 226 (1953).

A strain of *Chlorella* operating at 102.2° F. converts sunshine into food at efficiency five times that of any previously known photosynthetic organism. It produces 100 times its own cell vol. of oxygen per hr. instead of the 20 times produced by most photosynthetic organisms over sustained periods.

MICROBIOLOGY

The multiplication of bacterial viruses.

STENT, G. S. *Sci. Am., 188,* 36-9, May, 1953.

Expts. using radioactive tracers are described in which reproduction of viruses was studied. It was shown that 24 min. after entering a bacterium the virus can manuf. 200 replicas of itself.

Bacteriology of the healthy experimental animal.

SCHWEINBURG, F. B., AND SYLVESTER, E. M. *Proc. Soc. Exptl. Biol. Med., 82,* 527-30 (1953).

The organs of normal rats, guinea pigs and golden hamsters are sterile. Blood from vena cava, bile and urine of normal dogs and rabbits was always sterile. Most of the tissues of healthy dogs, and rabbits to a lesser degree, harbor clostridia. The embryos of healthy dogs are sterile. The great majority of the strains recovered from the tissues of dogs and rabbits show all the morphological and cultural characteristics of *Cl. welchii* (perfringens). Toxin production, though weak, was demonstrated.

Reversal by complex natural materials of growth inhibition caused by antibiotics.

FOSTER, J. W., AND PITTILLO, R. F. *J. Bacteriol., 65,* 361-7 (1953).

Four to 8 times the level of penicillin, streptomycin, aureomycin, chloramphenicol, terramycin, and bacillin are required for complete inhibition of *E. coli* in the presence of 100 to 1,000 γ per ml. of complex org. supplements than in their absence. This is believed to be a reversal of antibiotic inhibition rather than destruction of the antibiotic.

Potential infectious hazards of common bacteriological techniques.

ANDERSON, R. E., STEIN, L., MOSS, M. L., AND GROSS, N. H. *J. Bacteriol., 64,* 473-81 (1952).

Aerosols laden with bacteria in sufficient nos. to infect lab. workers are released during the performance of many common lab. technics.

NUTRITION

Trends and needs in nutrition.

SEBRELL, W. H. *J. Am. Med. Assoc., 152,* 42-4 (1953).

A reoriented nutrition program in this country is much needed, with increased emphasis on clinical research aimed primarily at obesity, chronic diseases, and borderline deficiencies. In addn., there is need for intensified research on the special nutritional requirements of the aged and persons under stress.

Dietary requirements of the aged.

HORWITT, M. K. *J. Am. Dietet. Assoc., 29,* 443-8 (1953).

The review includes data on carbohydrate metabolism, vitamin requirements, protein metabolism, habit patterns, physiologic changes, practical measures.

Nutrition and blood pressure.

WILHELMJ, C. M., MCDONOUGH, J., AND MCCARTHY, H. H. *Am. J. Digest. Diseases, 20,* 117-21 (1953).

Carbohydrate and fat influence blood pressure only in so far as they influence body wt.

Amino acids and proteins: their place in human nutrition problems.

FLODIN, N. W. *J. Agr. Food Chem., 1,* 222-35 (1953).

This review collects and correlates the evidence on the manifestations and prevalence of protein deficiency and on the means available for extending the effective protein supply without a corresponding increase in food production.

Effect of antibiotics on rats fed amino acid-supplemented rice diets.

PECORA, L. J. *J. Nutrition, 49,* 621-9 (1953).

Penicillin and aureomycin added to a lysine- threonine-supplemented rice diet with a nitrogen content equiv. to 6.17% protein produced a growth response in weanling rats approx. equal to the growth obtained with diets contg. 15% casein. Penicillin generally gave the greater growth stimulation. Chloromycetin, bacitracin, streptomycin, and terramycin had little or no effect in this diet.

Soyin, a toxic protein from the soybean. I. Inhibition of rat growth.

LIENER, I. E. *J. Nutrition, 49,* 527-39 (1953).

The procedure for prepg. purified soyin on a large scale from defatted soybean flour is described in detail. When soyin was fed to young rats at a level of 1% in a diet contg. autoclaved soybean protein or casein, growth was inhibited 26% and 18%, resp. Crude trypsin was not effective in counteracting this inhibition of growth. Equalization of food intake failed to reveal any significant differences in the growth of rats receiving diets with or without soyin. On the basis of comparable expts. with raw soybean meal in the presence and absence of crude trypsin, it is estd. that about half of the growth-inhibiting effect of raw soybean meal is due to its soyin content and the remainder to an effect which can be counteracted by crude trypsin. Growth impairment by soyin was attributed to a decrease in the quantity of food consumed.

Lack of effect of amino acids on the growth retardation due to unheated soybeans.

HILL, C. H., BORCHERS, R., ACKERSON, C. W., AND MUSSEHL, F. E. *Arch. Biochem. Biophys., 43,* 286-8 (1953).

A mixt. of essential amino acids included in the ration failed to prevent or reduce the chick growth retardation caused by feeding unheated soybeans. This finding is not in accord with the theory of growth retardation due to proteolytic inhibition.

Vitamin B_{12} and folic acid in milk diets.

COLLINS, R. A., SCHREIBER, M., ELVEHJEM, C. A., AND HART, E. B. *J. Nutrition, 49,* 485-94 (1953).

The inferior growth of rats fed a mineralized goat's milk diet was found to be the result of a vitamin B_{12} deficiency. Rat growth equal to that obtained with a cow's milk diet was attained when 0.5 γ of vitamin B_{12} was added per rat per day to a goat's milk diet, or when 3 γ of vitamin B_{12} were added per liter of goat's milk.

Rays kill vitamins.

Cancer, 116, 1, May 11, 1953.

Expts. with milk and other dairy products showed that 70% of the vitamin A in raw whole milk was destroyed by a six-hr. exposure to gamma radiation, along with 37% of the riboflavin and all of the reduced ascorbic acid. Butter, cheese, and cream showed similar effects.

Decreased activity and energy balance in the hereditary obesity-diabetes syndrome of mice.

MAYER, J. *Science, 117,* 504-5 (1953).

The purpose of the study was to quantitate the difference in activity between obese and nonobese animals, and to see how it varied with age and degree of obesity. Decrease in activity precedes marked obesity and represents a not unimportant factor in the etiology of this form of obesity.

PHARMACOLOGY AND TOXICOLOGY

Carcinogenic azo compounds: chemical constitution and carcinogenic activity.

BAIGER, G. M., AND LEWIS, G. E. *British J. Cancer, 6,* 270 (1952); *J. Am. Med. Assoc., 151,* 773-4 (1953).

Some investigators reported that the addn. of *o*-aminoazotoluene to food leads to malignant liver tumors in rats. Scores of other azo compds., which are used as textile dyes and some for food coloring, have been tested for carcinogenic activity and while many have been shown to be active, most of the food-coloring matters failed to induce liver tumors in rats. In any case, it is most unlikely that anyone could ever consume enough of an azo compd. in food to have any deleterious effect.

(Continued on page 18)

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SELECTED ABSTRACTS

(Continued from page 16)

Effects of basal diets on the response of rats to certain dietary non-ionic surface-active agents.

CHOW, B. F., BURNETT, J. M., LING, C. T., AND BARROWS, L. *J. Nutrition, 49,* 563-77 (1953).

When 23-day-old weanling rats were fed a basal casein diet supplemented with 5% polyoxyethylene sorbitan monostearate (Tween 60), diarrhea developed during the initial period of feeding and the growth rate was retarded. On the other hand, supplementation of this surface-active substance or of two similar agents, such as Myrj 52 or Span 60, to a soybean meal basal diet, even at a 15% level, did not produce these deleterious effects except in the animals on Span 60. These rats consumed less food and consequently grew at a slower rate than those on other emulsifiers or those serving as controls. At the end of 14 weeks of feeding, animals on both 15 and 5% levels were sacrificed. No abnormal histological or pathol. changes were observed. To test whether older rats would be more susceptible to any possible deleterious properties of the agents, rats of one year of age or older were fed 5% Tween 60 in the soybean basal diet for 14 weeks. No loss of wt. or development of diarrhea was observed. From these results it was concluded that, depending on the basal diet used for supplementation, each of the three non-ionic emulsifiers investigated in this study produced no observable toxic effect.

Toxicity of non-ionic detergents for the chick embryo.

HERRMANN, H., LUBCHENCO, L. O., AND ROTHFELS, U. *Proc. Soc. Exptl. Biol. Med., 82,* 392-5 (1953).

Two non-ionic detergents, Tween 80 and Triton X-100, were compared with respect to their toxicity to chick embryos. Tween 80 was found to be 20 times less toxic than Triton X-100. The possibility is considered that with the increasing age of the embryos there is a decrease in the toxicity of both detergents.

Toxicity of butyl stearate, dibutyl sebacate, dibutyl phthalate, and methoxyethyl oleate.

SMITH, C. C. *Arch. Ind. Hyg. and Occupational Med., 7,* 310-18 (1953).

The plasticizers were examd. for acute and chronic toxicity in rats. The finding suggests that these plasticizers are metabolized in the body in much the same way as the fat normally ingested in the diet. Based on these data in rats, butyl stearate and dibutyl sebacate when incorporated in films for wrapping foods appear to possess little, if any, potential hazard for humans, the calcd. safety factor being in excess of 1,400.

Considerations on the safety of arsanilic acid for use in poultry feeds.

FROST, D. V. *Poultry Sci., 32,* 217-25 (1953).

Poultry show a high degree of tolerance to arsanilic acid, i.e., ratio of toxic level to maximal permissable level at least 5:1. Arsenic retention is greatest in the liver and least in muscle, and is proportional to the level fed. The stored As disappears most rapidly from the liver, and less rapidly from the muscle and skin, following removal of the arsenical from the diet. Arsenic retained by chickens does not appear to represent a hazard to the consumer in terms of cumulative As intake. The inherent toxicity of arsenicals must, nevertheless, be recognized so that proper handling will be insured. A direct colorimetric method is available for the dctn. of arsanilic acid in feeds.

Intravenous infusions into human subjects of fractionated coconut oil emulsions.

SHAFIROFF, B. G. P., MULHOLLAND, J. H., AND BARON, H. C. *Proc. Soc. Exptl. Biol. Med., 79,* 721-3 (1952).

Emulsions of the glycerides of the short chain fatty acids were toxic when injected intravenously into human subjects. The glycerides of the high mol. wt. fatty acids, lauric, myristic, palmitic and stearic acids were non-toxic when injected in emulsion form. Inclusion with the latter of small concns. of the fatty acid esters of the type of oleic and linoleic acids did not affect the toxicity of the emulsions.

Comparative toxicity of synthetic and natural glycerin.

HINE, C. H., ANDERSON, H. H., MOON, H. D., DUNLAP, M. K., AND MORSE, M. S. *Arch. Ind. Hyg. and Occupational Med., 7,* 282-91 (1953).

The chief pharmacologic effect of either natural or synthetic glycerin was stimulation of the central nervous system. Chronic toxicity studies showed that after rats had been fed 20% natural or synthetic glycerin for one year there were no significant differences between exptl. and control subjects. After rats had been fed 5 or 10% natural or synthetic glycerin for a period of 2 years, there were no significant differences as regards % of wt. gain, results of urinalysis and hemoglobin dctns., or percentage of mortality. There was no evidence of organ stress at any level of either glycerin, and there were no gross or microscopic lesions attributable to the glycerin feeding.

PHYSIOLOGY AND MEDICINE

Effect of potassium deficiency on gastric secretion in the rat.

CARONE, F. A., AND COOKE, R. E. *Am. J. Physiol., 172,* 684-8 (1953).

The compn. of gastric juice was studied in normal rats and in rats made potassium deficient but not alkalotic by a low potassium dict and injections of desoxycorticosterone acetate. Potassium deficiency was accompanied by a rise in pH of gastric juice, a fall in titratable acidity and in the concns. of potassium and chloride in gastric juice. The concn. of sodium in gastric juice rose from an av. of 49 mEq/l. in normal rats to 101 mEq/l. in the potassium-deficient animals. Partial repair of the potassium deficiency by the administration of potassium chloride led to a return of the compn. of gastric juice toward normal.

Some observations of effects of intravenous fat emulsions on erythrocyte fragility.

CREDITOR, M. C. *Proc. Soc. Exptl. Biol. Med., 82,* 83-7 (1953).

Intravenous infusion of fat emulsions causes increased mech. fragility of dog and human red blood cells. Spontaneous intravascular hemolysis has been seen in humans who have received these emulsions. The possible causes of this phenomenon and its possible relationship to the "pyrogenic" effects of intravenous fat are discussed.

Excretion and distribution of polyvinyl pyrrolidone as determined by use of radiocarbon as a tracer.

LOEFFLER, R. K., AND SCUDDER, J. *Am. J. Clin. Path., 23,* 311-21 (1953).

The excretion rate and distribution of nonexcreted polyvinyl pyrrolidone was studied in 4 patients, using carbon-14 labeled PVP-macrose as a tracer. About one-third was excreted in the urine in the first 6 hrs. and two-thirds in the first 24 hrs. Small amts. were excreted in the feces. The unexcreted portion showed a distribution consistent with that of any inert material of large mol. size, with kidneys, lungs, liver, spleen and lymph nodes tending to show the greatest concn. No histologic evidence of PVP itself, or damage caused by it, was demonstrated. Nothing can be concluded from these data about the effectiveness of PVP-macrose as a plasma extender or about possible physiologic damage resulting from its use.

Cancer as a problem of protein research: recent trends.

TOENNIES, G. *Texas Repts. Biol. and Med., 10,* 254-64 (1952); *Biol. Abstr., 27,* 918, No. 9888 (1953).

Attempts to characterize malignant tissue chemically included studies of enzyme and vitamin distribution and analysis of the amino acid content of tissue proteins. Although small differences were demonstrated, the most striking feature was the uniformity of compn. of malignant and of normal tissues. Recent work has shown that by fractionation of tissue proteins by electrophoresis it is possible to demonstrate marked dissimilarities between cancer tissue and normal tissue.

ENGINEERING AND PLANT EQUIPMENT

Grinding and crushing. Fundamental aspects of grinding; types of grinding mills; unusual techniques in grinding.

PIRET, E. L., ERICKSON, H. W., AND FOOTE, J. H. *Chem. Eng. Progr., 49,* 55-72 (1953).

(Continued on page 20)

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SELECTED ABSTRACTS

(Continued from page 18)

This is a series of three articles that furnish a brief convenient review of grinding from the basic engineering principles to current industrial practices. The first article discusses the theory of this unit operation while the last two cover the applications and the practical solns. offered by manufacturers of grinding machinery.

FOOD AND FOOD TECHNOLOGY

BAKING AND BAKERY PRODUCTS

Bread from untreated flour.

Food, 22, 77-8 (1953).

A new machine has been developed with which it is possible to make a good quality loaf from unbleached, untreated flour. The process, "improved method for making bread with untreated and unbleached flour," British Patent 646,311, is based on the use of high-speed beaters to incorporate sufficient air into a flour batter to bleach it and give a loaf of good volume.

Heat denaturation of gluten.

Pence, J. W., Mohammad, A., and Mecham, D. K. *Cereal Chem., 30,* 115-26 (1953).

Effects of time, temp., moisture content, pH, and salt concn. on the denaturation of gluten by heat were studied. The rates of denaturation at both 80° and 90° C. were negligible at low moisture contents but rose rapidly to maxima at 35-40% moisture; at higher moisture levels the rates declined slightly toward intermediate values. Denaturation of wet, gum gluten was slow at pH 4 but became rapid at higher pH values; the relations among pH, temp., and rate of denaturation were found to be quite complex. At low pH values damage to baking properties occurred which was not caused by heat. Variations in salt concn. had no effect on rate of denaturation by heat, but the presence of salts may influence the damage to baking properties caused by low pH conditions. Significant variation occurred among the rates of denaturation, as measured by the baking test, of glutens from flours of different quality, but no consistent trend was observed for glutens from flours of better quality to denature at higher or lower rates. The denaturation of a gliadin prepn. was much slower than that of the whole gluten complex and was characterized by a definite induction period.

An alkaline viscosity test for soft wheat flours.

Finney, K. F., and Yamazaki, W. T. *Cereal Chem., 30,* 153-9 (1953).

An alk. viscosity test using sodium bicarbonate instead of lactic acid is described. Alk. and acid viscosity values are correlated with cookie diams. Correlation coeffs. for alk. viscosity vs. cookie diam. of two sample groups were −0.93 and −0.98; whereas the r values for lactic acid viscosity vs. cookie diam. were −0.81 and −0.83, resp. Standard errors of estimate for alk. viscosity vs. cookie diams. were only 37 to 64% of those involving acid viscosity, and the differentiation or spread between varieties by alk. viscosity was about twice that by the acid test.

FATS AND OILS

U. S. D. A.'s all-climate edible spread destined for armed forces.

Chem. Eng. News, 31, 2066 (1953).

Typical compn. is 84 parts soybean salad oil, 16 parts distilled monostearate, three parts salt, with butter yellow, flavor, antioxidants and fat-sol. vitamins added. No water is present, therefore no sepn. of a water phase can occur. Hardness is controlled by varying monostearate content, and the product is not only spreadable at temps. below freezing but maintains its form up to 110° F. and above.

FEEDINGSTUFFS

Non-ruminants show increased gains using artificial rumen for pre-digestion.

Muhrer, M. E. *Feed Age, 3,* 34-6, May, 1953.

Protein content of a feed can be increased by fermentation with rumen micro-organisms using urea as a source of N. The crude fat portion increased during fermentation and was in turn accompanied by a decrease in urea and nitrogen-free ext. A significant amt. of crude fiber was also digested in the artificial rumen.

FISH AND SEAFOOD

Ribose and the Maillard reaction in fish muscle.

Tarr, H. L. A. *Nature, 171,* 344-5 (1953).

Although direct proof is not presented, it appears that the browning reaction in halibut and lingcod is due to the combination of ribose freed from nucleotides with the fish proteins.

FROZEN FOODS

Freezing tomatoes and tomato juice.

Refrig. Res. Foundn. Info. Bull., 53, 3 April 15, 1953.

Success in freezing tomatoes depends chiefly on quality of the tomato and speed of freezing. In general, the first picking of either field or hothouse tomatoes yields a much better product than the last or later pickings. Those from later pickings are often more watery than early or first-picking fruits and though they might serve well for juice, they do not serve well as whole, sliced or diced frozen tomato. High-speed freezing seems necessary for both whole or cut tomatoes and juice. Tomatoes that pass through the zone of crystal formation in less than 30 min., particularly those that have a tougher skin, seem to hold up quite well even after complete thawing. For salad use, a good product is obtained after an hr. of thawing, when it is still icy and slices well. Freezing at −20° F. was markedly superior to 0° F. for both juice and whole or cut tomatoes. There is apparently no assurance, however, that completely defrosted tomatoes will "stand up," which is the basic problem.

FUNGICIDES AND GERMICIDES

New germ-killer for canners.

Canner, 116, 39-41, May 4, 1953.

Movidyn is a colloidal suspension of metallic silver in a protective medium. The silver particles are in a highly dispersed state. The disinfectant will remain stable when stored at any temp. from freezing on up to 120° F. Suggested uses are as a wash water or sterilizer for bottles and containers, paper and packaging materials and as a spray for plant molds and mildew.

The influence of formamide on the bactericidal action of selected chemical compounds.

Cooper, E. A., and Goddard, A. E. *J. Appl. Chem., 3,* 129-32 (1953).

Formamide (20% aq. soln.) exerts a specific influence on the germicidal power of the satd. fatty acids, the bactericidal action on various microorganisms being increased fivefold to tenfold. The hydroxy-acids are affected by formamide to a much less extent, as also are phenols, isopropyl alc., and acetone. The monoalkyl tartrate esters are germicidal to *Bacterium aerogenes* in concns. from 1 in 250 to 1 in 500. Aliphatic esters, unlike the fatty acids, are not appreciably influenced in germicidal power by formamide. Acetamide and glycol have little effect on the bactericidal action of acids. Formamide increases the adsorption of both formic and acetic acids from dil. aq. soln. by activated charcoal. Possibly, the marked rise in the germicidal power of the acids in the presence of formamide is assocd. with an increased uptake of the acids by the bacterial colloids, making a higher concn. of acid within the cells available for disinfection.

GELATIN

Amide nitrogen of collagen and hide powder.

Cassel, J. M., and McKenna, E. *J. Am. Leather Chemists' Assoc., 48,* 142-54 (1953).

The amide nitrogen value of a purified collagen, of hide powder, and of gelatin was found to be 6.0, 3.8, and 1.9 mg. per g. of protein. The reaction involved in the hydrolysis of amide bonds in collagen at 100° C. follows first order kinetics until almost 90% of the reaction is complete. The specific reaction rate for the evolution of amide nitrogen from collagen at 100° C. by 0.2*N* HCl was calcd. to be 30.4×10^{-5} sec^{-1}. An activation energy of 18,300 cal. per mole was detd. for this

(Continued on page 22)

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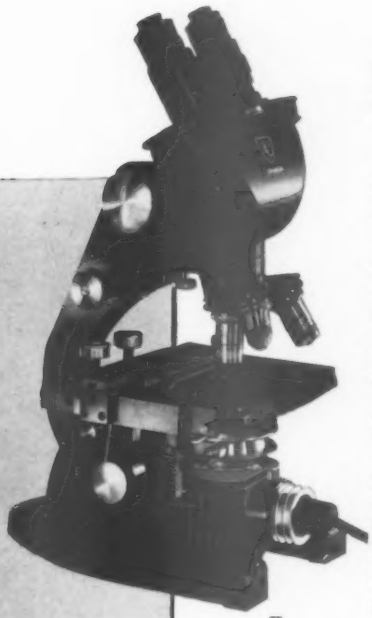

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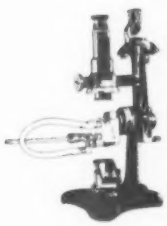

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SELECTED ABSTRACTS

(Continued from page 20)

reaction. The rate of liberation of amide nitrogen from collagen is shown to be much greater than from the reported rate for egg albumin. The catalytic effect on this reaction by the sodium salts of certain mono and dibasic sulfonic and sulfuric acids, i.e., sodium lauryl sulfate, is shown to be considerably greater than the effects reported for wool and egg albumin. The source of amide nitrogen in collagen is shown to be mainly asparagine rather than glutamine.

INSECT CONTROL

Use of fission products for insect control.

Hassett, C. C., and Jenkins, D. W. *Nucleonics, 10,* 42-6, December, 1952.

Insect infestation of finished and packaged products can be controlled with fission-product gamma rays. In tests with Co^{60} on six species of insects, reproduction was inhibited with 16,000-32,000 r; 64,400 r doses were completely lethal.

MILK AND MILK PRODUCTS

Heat processing and the nutritive value of milk and milk products.

Schroeder, L. J., Iacobellis, M., and Smith, A. H. *J. Nutrition, 49,* 549-61 (1953).

Tests on adult dogs showed that autoclaving whole raw milk at 10 or 15 pounds' pressure for 15 or 30 mins. has no detrimental effect on the protein as measured by digestibility, biol. value or nutritive index. It was also found that the digestibility and biol. value of milk protein do not change if milk is kept in frozen storage for 5 months. It was observed that, under the exptl. conditions employed, com. processing as used in the prepn. of evapd. milk and milk powder does not decrease the nutritive value of the protein constituents.

The effect of heat on the albumin and globulin in milk.

Ramsdell, G. A., and Whittier, E. O. *J. Dairy Sci., 36,* 437-9 (1953).

The albumin and globulin of milk may be denatured by heating the milk and are thus rendered coagulable by acid, salts, or rennet, but they are not coagulated or even aggregated to the size of the particles of the casein complex merely by heating.

PECTIN

The gelation of pectin in uncooked jam from frozen red raspberries and strawberries.

Kramer, M. A., and Sunderlin, G. *J. Home Econ., 45,* 243-7 (1953).

Uncooked jams of satisfactory consistency and distinctive fresh fruit flavors were made from frozen red raspberries and successfully subjected to freezer storage. The probability of success when uncooked red raspberry jams are made in the home is increased by the wide range of acceptability in rates of stirring, temps. of mixing, sugar concns., proportions of pectin, and com. brands of both frozen fruit and of pectin. The relatively few expts. with frozen strawberries indicated a narrower range of satisfactory proportions than with the red raspberries, and the proportion of pectin to fruit for satisfactory gelation had to be higher. Recipes were developed for red raspberry and strawberry jams using both liquid and powd. pectin and com. frozen, fresh or home frozen fruit.

PACKAGING

Carbon, silica gel packet doubles food shelf-life.

U. S. I. Chem. News, April, 1953.

Small packets of activated C and silica gel, for inclusion in food packages to double the shelf-life of potato chips, nuts, candies, and other moisture-sensitive products, are now available to food manufacturers. Purpose of the silica gel is to absorb moisture which enters the package; activated C is included to absorb unpleasant odors that develop even when these foods are sealed and protected from moisture. The protective agents are enclosed in a small perforated cellophane bag to eliminate the danger of their being consumed with the food.

PHYSICAL RESEARCH

Dynamic gas adsorption method of surface area determination.

Blocker, H. G., Craig, S. L., and Orr, C. *J. Phys. Chem., 57,* 517-20 (1953).

Investigations of the phenomenon of gas adsorption, as well as investigations of gas adsorption methods for surface area detns., have been primarily concerned with equil. measurements, and dynamic measurements have received little attention. Therefore, two technics, one approximating equil. conditions and one requiring a measure of the rate of adsorption, were investigated. Both are shown to give surface area results in satisfactory agreement with those of equil. measurements.

RADIOCHEMICAL TECHNOLOGY

The isotope dilution procedure of analysis. I. Historical and literature survey.

Pinajian, J. J., Christian, J. E., and Wright, W. E. *J. Am. Pharm. Assoc., 42,* 301-4 (1953).

The isotope diln. procedure of analysis, a relatively new technic, offers intriguing possibilities and is of sufficient importance to warrant special attention at this time. The history of the procedure and a survey of the literature are presented.

PATENT

Chewing gum base material.

Hewitt, E. J., and Berdick, M. Assignors to American Chicle Company. *2,635,964,* April 21, 1953.

A synthetic non-crystalline chewing gum base resin constituent consisting of the reaction product of com. dodecene, maleic anhydride and tall oil having a carbon to carbon conjugated double bond, with a mixt. of polyhydric alcohols.

Books

Ion Exchangers In Analytical Chemistry. Olof Samuelson. John Wiley & Sons, Inc., 440 4th Ave., New York 16, N. Y. 291 pp. 1953 ($6.50).

Ion exchange resins have been utilized for a variety of purposes and their uses have been greatly extended since the introduction of synthetic resins homogeneous with respect to the strength of their acidic or basic groups. Purification of reagents, separation of constituents from biological fluids, catalysis, and fractionation of amino acids, of rare earth elements, and of organic acids are only a few of the applications that have been devised. Despite widespread knowledge, there are limitations both in the mechanics of operation and the chemical stability of resins which are not generally known. Professor Samuelson has undertaken the task of compiling information on the uses of resins in analytical chemistry, organizing this knowledge in a useful form, and pointing out the pitfalls and difficulties wherever they may occur. He has succeeded admirably.

The scope of the book is indicated by the following chapter headings:

II. Fundamental Properties of Ion Exchange Resins.
III. Ion Exchange Equilibria.
IV. Ion Exchange Kinetics.
V. Ion Exchanger in Column Operation.
VI. Technique of Ion Exchange Separations for Analytical Purposes.

(Continued on page 24)

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BOOKS

(Continued from page 22)

VII. Technique of Ion Exchange Chromatography.
VIII. Determination of Total Salt Concentration.
IX. Removal of Interfering Ions in Inorganic Analysis.
X. Inorganic Colloids and High Polymer Electrolytes.
XI. Isolation of Trace Constituents.
XII. Inorganic Qualitative Analysis.
XIII. Chromatographic Separations in Inorganic Chemistry.
XIV. Isolation of Low-Molecular-Weight Organic Acids.
XV. High-Molecular-Weight Organic Electrolytes.
XVI. Aldehydes and Ketones.
XVII. Sugars and Polyhydric Alcohols.
XVIII. Sulfite Waste Liquor.
XIX. Alkaloids.
XX. Amino Acids.
XXI. Nucleotides, Nucleosides, and Purine and Pyrimidine Bases.
XXII. Vitamins.
XXIII. Antibiotics.
XXIV. Other Biochemical and Biological Applications.
XXV. Investigations of Complex Salt Solutions.
XXVI. Purification and Recovery of Analytical Reagents.

Each of the analytical methods is described in sufficient detail to enable the investigator to evaluate the applicability of the ion exchange method to his problem. In most cases, the procedure with specific instructions, the limitations, advantages, and possible side reactions are all given in clear-cut, explicit language. Those sections such as amino acids, organic acids, carbohydrates, water and milk analysis with which the author has had experience, were well documented, contained recent information, and were free of errors. The literature survey up to publication time appears quite complete.

This book is recommended to analysts whether they be food technologists, biochemists or agricultural chemists. The background and mechanics of ion exchange reactions are sufficient for all practical purposes. The instructions are so clear and complete that recourse to the original literature will be seldom necessary. The only criticism the reviewer has is not one directly applicable to the book so much as it is to research on ion exchangers. Experimental design in this field has not led to definitive experiments which allow an investigator to determine whether flow rates, particle size and temperature are all factors related to rate of diffusion of the exchanging ions or to some combination of controlling variables. More exact information would allow a better selection of levels of these factors for analytical purposes.

HARRY S. OWENS
Albany, California.

GLYCEROL. Edited by Carl S. Miner and N. N. Dalton. A. C. S. Monograph No. 117. 460 pages, Reinhold Publishing Corporation, New York 36, New York, 1953.

This book supplants a part of the well-known A. C. S. Monograph No. 44 "Glycerol and the Glycols" by Lawrie, published in 1928. The glycol portion of Lawrie's monograph has also been brought up to date and published as a separate monograph. Although six authors contributed the eleven chapters comprising the book, more than 90 percent of the material was written by J. B. Segur and Truman N. Godfrey. The latter, a consulting chemical engineer, contributed three chapters on sources, production and recovery, and refining of glycerol. The preface states that "It is realized that the skill and experience required to operate a glycerine refinery cannot be transmitted successfully through a book. The chapters covering these subjects are not designed to serve as an operator's manual, but rather to give helpful information to those who require a general knowledge of the subject." This aim is admirably met, since much detailed information is given on the composition of the fats and oils (the ultimate source of natural glycerol) and on the production and refining of these oils, their saponification and hydrolysis as well as on the recovery and refining of the glycerol. A description of the chemical synthesis of glycerol, written by the staff of the Shell Development Company, is included in this section of the book, and adds to its completeness.

The five chapters written by J. B. Segur of the Miner Laboratories contain much of interest to the food technologist who uses glycerol, or who is considering its use. The chapter on standards and specifications reproduces the United States and British Pharmacopeias, Federal Specifications for glycerol, and the American Chemical Society Specifications for reagent-grade glycerol, and also describes the other grades that are commonly available. The chapter on analysis gives detailed instruction for sampling, qualitative tests and the quantitative determination of glycerol by the generally accepted standard methods and by several other methods that have been reported. For the determination of glycerol in foods, however, the reader is given specific references to books on the analysis of foods. Chapters on the physical and chemical properties of glycerol are both complete and up to date, and anyone dealing with glycerol or its derivatives will find these chapters useful. Physical data are included for solutions of glycerol. The chapter on chemical properties includes the preparation and physical and chemical properties of many esters and ethers of glycerol and the formation and properties of many interesting inorganic compounds of glycerol. A chapter on the uses of glycerol was found to be of added value because mention is made of the properties of glycerol that adapt it to the described use. This chapter is divided as to uses in foods, tobacco, medicine, etc.

Two other chapters also contain material of interest to the food technologist. One, on the biochemical use of glycerol is the work of C. H. Werkman of Iowa State College. The other, on the physiological action of glycerol was prepared by Martin E. Hanke of the University of Chicago, who quotes the following: Ingestion of 30 ml. of 95% glycerol three times a day by each of 14 graduate students for 50 days had no undesirable effect, except a slight tendency toward increased weight,

BOOKS

due to the increased caloric intake, since the glycerol ingestion was in addition to the regular food intake; rats have survived 30 weeks on a diet consisting of 60% glycerol, without loss of weight.

The reviewer is inclined to doubt that hydrogenation of the fatty *acids* is a general method for preparing the corresponding alcohols (page 72) and also the statement on page 119 that "the vapor pressure of glycerol is much higher than that of water . . . " but still finds the book to be remarkably free of errors. It is well printed and bound, as are other A. C. S. Monographs, and is recommended to chemists and food technologists having an interest in any phase of this subject.

W. Gordon Rose
Albany, California

Starch. C. A. Brautlecht. 408 pages. Reinhold Publishing Co., 330 W. 42nd Street, New York 36, N. Y. 1953. $10.00.

This book primarily is a treatise on the technology of starch manufacture and, to some extent, on the economics related to starch production.

At the beginning a few pages are devoted to general considerations and a few to the physical structure of starch granules with photographs of granules and comments relative to various types of granules.

The author shows his knowledge of one phase of the industry by adequately treating in some 120 pages the growing and handling of potatoes for starch production and the processing into starch. This is an excellent treatment and gives the reader a very clear concept of the problems of the potato starch industry as well as details of manufacture, specifications, and so forth.

In contrast to the extensive treatment of potato starch only some 25 pages are devoted to corn starch and its production. The sweet potato industry and the manufacture of sweet potato starch merits some 36 pages.

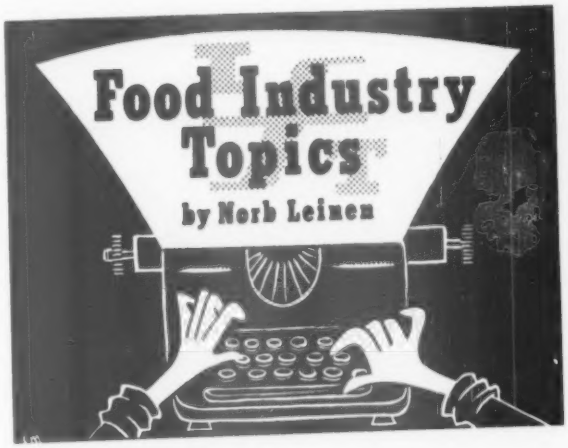
The reviewer feels that the book is somewhat out of balance. Its title might indicate essentially equal emphasis on various types of starch. However, the author does cover all phases of, as indicated on the fly leaf, "Starch—its sources, production, and uses." In addition to those named above, there are treatments of tapioca, wheat, rice, sago, and arrowroot.

The final sections on the applications of starch, modified starch, and starch products, while not as complete a treatment as the sections on sources and production, do give a general picture rounding out the treatment.

In view of the adequate treatments already available on the chemistry of starch the final chapter by Owen S. Moe seems rather superfluous. However, it might be of help to those readers who want a little knowledge of this complex subject.

All in all the book must be highly recommended for its good features and not too severely criticized for its deficiencies. It is an excellent treatise for those interested in starch manufacture and the economics thereof. It brings together information difficult to locate elsewhere and certainly fills a need in the starch literature.

Eric Kneen
Milwaukee, Wisconsin



. . . in the public interest

Research at the Georgia Experiment Station at Experiment, Ga., is adding to the U. S. Army's knowledge of storing military rations. The Chicago QM Food and Container Institute has recently renewed a five-year contract with the Food Processing Department of the Georgia institution. Under the supervision of Dr. J. G. Woodroof, chairman of the Division of Food Processing of the University of Georgia, and in coordination with Dr. J. H. Mitchell, Jr., of the QM Institute, the renewed contract is an extension of two previous years of research in this field by the Experiment scientists. The work consists of testing military rations for their shelf life at temperatures ranging from minus 20° to plus 100° F. and relative humidity ranges from 40 to 95%. Explaining this work, Dr. Woodroof said, "Climatic and weather conditions of the entire world will be replicated in our laboratories and military rations subjected to these artificial conditions will be carefully watched by our food technicians to see how and when they react." Containers as well as the approximately 50 items of food will be tested. The rations consist of soluble coffee, crackers, bread, peanut butter, ham, beef, cheese, milk, soup, fruit cocktail, ice cream powder, and many others. About 34 of the food items will be in cans and 16 stored in flexible containers.

◆ ◆ ◆

Much wider application of atomic energy in plant science was predicted by Dr. Raymond Blackmore, Battelle Institute, Columbus, Ohio. The research scientist based his prediction on (1) the increasing availability of radioisotopes, (2) steadily improving technology on their use in agricultural research, and (3) the increasing number of personnel trained in the techniques and handling of radioactive materials. The radioactive tracer technique, when coupled with other analytical procedures, is more sensitive and more specific than any other method of analysis known, Dr. Blackmore said. It is the only analytical technique which has the power to observe chemical activities of individual batches of atoms, ions, and molecules within cells, organisms, and other systems. Dr. Blackmore stated that more than 1200 shipments of radioisotopes have been made from Oak Ridge to some 125 institutions, for studies in plant physiology and animal husbandry. The receiving institutions have been spread out through nearly every state, Hawaii, and Puerto Rico. In addition, many of these institutions have received shipments of specially synthesized radioactive compounds from commercial suppliers, while others have received radioactive fertilizers from the USDA facilities in Beltsville, Md.

(Continued on page 28 following technical papers)

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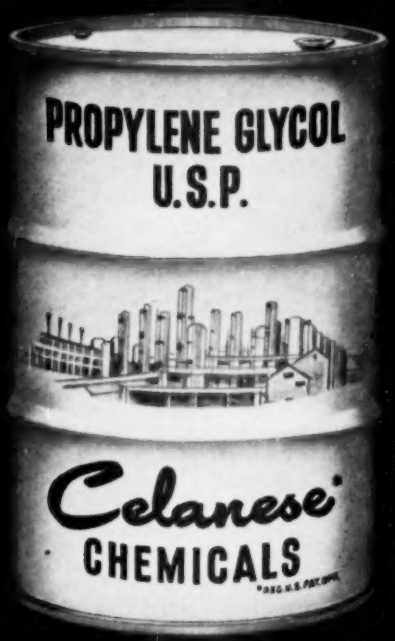

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The Metabolic vs. the Toxicological Approach in the Evaluation of the Safety of Food Additives[a,b]

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(Manuscript received July 3, 1953)

It is generally agreed that, before a manufacturer adds a new chemical to a food product, there must be conclusive proof as to the innocuousness of the additive. The extent of the evidence required in the case of foods must of necessity be much more stringent than that needed before the use of new drugs can be permitted.

There are a number of valid reasons why a more extensive proof is required for the harmlessness of a proposed additive to a food product than for a new drug. In the first place, when the chemical in question is present in foods, it may be continuously ingested over an indefinite period of time, while a drug is usually taken over a limited interval. Secondly, once a product is permitted as an additive to foods, no general medical examination of the persons who consume it is made to determine whether or not any deleterious effect has been caused by the product. On the other hand, when a new drug is released, its use is usually permitted to a very limited extent, and only under strict clinical supervision and observation. In the case of the food additive, the person consuming it may be entirely ignorant of the presence of this material in the food. Moreover, even though a person is conscious that there is such a product, it may be added to a number of different foods which are consumed at the same time, so that he would be ignorant of his actual intake. In contradistinction to this circumstance, a medicine is practically always taken with the knowledge of the patient and in a well-defined maximum dosage. One can understand why the Food and Drug Administration has, justifiably, been much more strict in the criteria applied to food additives than in those set up for drugs *(18)*.

The most widely employed procedure to determine whether or not a substance is harmless is the toxicological approach. By this method, one seeks to determine whether or not the material produces toxic effects when administered at several hundred times the level at which it would normally be ingested. One does not have the advantage of previous experience, and one is pioneering in a new field with each product tested.

MINIMUM TOXICOLOGICAL TESTS

The following are the usual minimum tests which must be carried out in a general toxicological study:

a. The determination of the LD_{50} of the chemical being examined is carried out on one species, and confirmation on a second species of animal. The condition of the test animals should be followed for at least 5 days. If animals recover and are gaining weight by the end of that interval, the test is considered negative. Suitable control experiments should be instituted to determine whether or not the mere bulk of the material fed causes a toxic reaction. In our earlier studies on stearyl and isopropyl citrate *(5, 10)*, we carried out our main determinations on rats. Confirmatory tests were made on dogs at high dosages which were below the LD_{50} level which had previously been established on rats.

b. Acute tests are usually carried out over a period of 6 weeks; the test material is included in the basal diet at several levels. In our tests with isopropyl citrate *(10)*, the material was given in amounts of 0, 0.64, 1.8, 2.7, and 5.3%, while in those with stearyl citrate, the chemical was added to the diet at levels of 0, 1.3, 2.5, 5.0 and 10.0%. One uses such tests to determine at what levels the material should be employed in the chronic tests, and to observe the nature of the symptoms which may develop from the continued ingestion of the material over a period of time. If the animals die during the acute tests, an examination of the cause of death should be made, to establish the cause of death, preferably by gross pathological examination of the organs and then by histopathological examination of the tissues. Acute tests should be carried out on at least 3 species, one of which is a non-rodent. Tests on dogs are usually considered essential.

c. Chronic tests are, in general, considered the most important criteria to determine whether or not food additives are harmful. These are usually continued for 2 years and, in the case of rats, are essentially longevity tests. All important tissues are removed from the experimental and control animals at the end of the tests, for histopathological examination. One difficulty, which always arises in the interpretation of changes in the tissues, is to distinguish between changes to be ascribed to the chemical fed and those which are to be traced to the vicissitudes of old age.

d. A modification of the longevity tests which provides more information during the same period of time is the multigeneration technic. Since it is recognized that pregnancy is a more critical physiological function than growth, and that lactation provides a still more useful index of well-being, a test which includes all of these functional states will provide much more information than does the usual chronic test. Thus, it is well known that a diet which may be satisfactory for maximum performance over one generation may become deficient for animals maintained on it for several generations. Similarly, a substance which might exhibit only a slight deleterious action or have no demonstrable effect whatsoever on the first generation, might very well cause progressively more serious complications when the ingestion was continued over the second, third, or fourth generations. In the case of rats, it is very easy to complete tests on 5 generations over a 2-year period. Our own records include the rate of growth from weaning to 90 days, fertility, size of litters, 21-day weight of rats, and the number of young the mother is able to bring to weaning.

e. Determinations are made of any toxicity which may develop in the foods containing the additive as a result of conditions to which the food containing the test substance may be subjected. Thus, in our tests on isopropyl and stearyl citrates *(10)* it was considered desirable to determine whether or not subjecting oils containing the citrates to high temperatures might result in the formation of any toxic products. Since these substances were to be incorporated into fats which might be subjected to deep-fat frying, this question was in order. Consequently, growth tests were made using fat containing the citrates in which successive batches of potato chips had been prepared by frying them at 205 to 210° C. over an 8-hour period. Since no depressing effect on growth was noted in consequence of this abuse of the fat containing the additives, it was considered that

[a] Presented at the Boston meeting of the Institute of Food Technologists, June 23, 1953 (Paper 41).

[b] Contribution No. 348 from the Department of Biochemistry and Nutrition, University of Southern California.

prolonged heating did not cause the formation of toxic compounds from the added isopropyl or stearyl citrate.

f. The most important fact to establish in such a series of tests is that the product used in the tests is what it is stated to be. If the product is one which is obtained from a well-established manufacturer, as for example the sodium benzoate used in some recent tests which we carried out, the use of an unopened bottle of the product probably requires no further proof of identity of its contents. However, when there is some question as to source of the material, or if it has been obtained from sporadic rather than a routine production, or where one may question the integrity of the food manufacturer attempting to obtain a clearance for his product, it is essential that the laboratory making the several tests previously outlined also prove by adequate physical and chemical procedures the identity of the material which is undergoing biological testing.

METABOLIC TESTING OF ADDITIVES

In addition to the tests listed above, the Food and Drug Administration has constantly emphasized the importance of carrying out metabolic testing. Such information as the rate of absorption, the effect on digestibility of foodstuffs, and the mechanism of oxidation or removal from the body, are all pertinent facts to be determined in testing additives under investigation.

The accumulation of such information is time-consuming and expensive. A single pathological report may be sufficient to negate completely several years' work, and the expenditure of many thousands of dollars. Any modification of the procedure which will shorten the prolonged period of testing and which will consequently lessen the expense of having a product accepted for use will naturally be most welcome. When it is possible to employ the metabolic approach in a study of toxicity, the time required to obtain the essential information may frequently be considerably abbreviated. At the same time, the information gained by the metabolic approach may be more pertinent than that gained from prolonged feeding tests.

There are a number of compounds of considerable importance to the food industry whose safety can be or has been proved by the use of the metabolic approach. Thus, when the substance in question is a product formed during the normal intermediary metabolism of any of the foodstuffs in the body, one has presumptive evidence of the harmlessness of the product. Even if the material under investigation is not normally present in the tissues, the demonstration that it can be metabolized by way of the well-known pathways similar to those of normally-occurring substances will go a long way toward proving its innocuousness.

One of the substances with which a metabolic study can be carried out is stearyl citrate. This is composed of two normally-occurring metabolites, namely stearyl alcohol and citric acid, which are combined in the form of an ester. It has been definitely proved by the use of the isotope technic that stearyl alcohol is a substance being constantly produced in the walls of the gastrointestinal tract by the reduction of stearic acid *(25)*; the reverse change has likewise been shown to occur *(25)*. Moreover, stearyl alcohol has been demonstrated to be a normal component of dog feces *(23)*. On the other hand, citric acid has been recognized as a constituent not only of vegetable products such as citrus fruits, but also of such animal products as milk. Of much greater import from the standpoint of establishing its harmlessness, is the proof that citric acid is synthesized in the body. We now know that, in the course of utilization of both carbohydrate and fat for energy, a reaction occurs which results in the formation of citric acid. This was formerly called the Kreb's cycle, or the citric acid cycle; now it is more frequently referred to as the tricarboxylic acid cycle *(15, 24)*.

In spite of this favorable basic information as to the natural occurrence of the hydrolysis product of stearyl citrate in the animal body, it was necessary to carry out the prolonged feeding tests, because no one could positively state whether or not the combination of stearyl alcohol and citric acid in ester linkage had conferred any harmful properties upon the new compound. After the prolonged tests, no harmful effects could be observed *(10)*.

Another example of the applicability of this type of experiment is the investigation as to whether or not the monoglycerides may exhibit harmful effects. Thus, it has long been postulated that monoglycerides are formed in the gastrointestinal tract as the result of the partial hydrolysis of the triglyceride molecule. Frazer and Sammons *(13)* proved that mono- and diglycerides were present in the intestinal contents of rats during the hydrolysis of triglycerides by pancreatic lipase. Mattson and co-workers *(20)* were able to establish, in an unequivocal manner, not only that monoglycerides originate during the digestion of triglycerides, but also that apparently the 2-monoglyceride is formed almost exclusively. This compound must arise from the 1,2-diglyceride which is the primary decomposition product of the triglyceride molecule in the intestinal tract. Kuhrt and associates *(17)* also identified monoglycerides in the intestinal contents of human subjects. Finally, Reiser *et al. (22)* have reported that, whereas 25 to 45% of the ingested triglycerides are completely hydrolyzed in the gastrointestinal tract, 55 to 75% are hydrolyzed only to the monoglyceride stage, to be absorbed as such.

The metabolic approach to the problem of the toxicity of monoglycerides can be extended to the proof of their presence in tissues other than those of the gastrointestinal tract. Thus, they have been identified as a minor constituent of the adrenal lipids *(21, 26)* as well as of normal pancreas *(14)*. Moreover, Kuhrt and associates *(16)* reported the presence of monoglycerides in lard and in bread; in the latter case, increased amounts occurred following baking.

The usual toxicological approach has likewise yielded positive evidence of the innocuousness of the monoglycerides. Thus, Ames and collaborators *(1)* recorded that growth and reproduction of rats fed diets containing 15 or 25% monoglycerides, over 3 generations, were just as satisfactory as in rats fed diets containing cottonseed oil. Mattson and Beck *(19)* have likewise obtained as good growth when mono- and diglycerides were incorporated into the diet as when corresponding amounts of neutral fat were used. These results also confirm the earlier studies of Braun and Shrewsbury *(2)*, who studied the nutritional value of monostearin. I might also add that we have in progress, in our own laboratory *(7)*, multigeneration studies on rats which have now reached the 36th generation. The original tests were started in 1940. The vegetable margarine fat used in the diet contains approximately 0.1% monoglycerides. Thus, we see that the question of harmlessness of monoglycerides, which has been answered in the affirmative on the basis of metabolic tests, has likewise been answered similarly by the type of test required according to the usual toxicological approach.

Sorbic acid offers another example of a food additive in which the weight of evidence of innocuousness can best be based upon metabolic study. This acid, which is 2,4-hexadienoic acid, is a doubly-unsaturated acid closely related to the naturally-occurring saturated acid, hexanoic (or caproic) acid. Thus, sorbic acid is oxidized to ketone bodies by liver slices *in vitro* in the same way as is caproic acid *(6, 27)*. In fact, Witter

et al. (28) stated that "sorbic acid, an unsaturated 6-carbon acid, was used as a model substrate."

In work to be published shortly *(8, 9)*, it has been found that sorbic, caproic, and butyric acids yield the same amounts of ketone bodies when fed in equimolecular doses at 2 levels as their sodium salts to fasting rats. It was likewise found that the ketone bodies disappear from the urine to an equal extent in the case of the several acids when glucose is administered in small doses. Under such conditions, all 3 acids are oxidized to carbon dioxide and water to yield their entire caloric value to the animal. As further supporting metabolic evidence, it was found that the qualitative distribution of the ketone bodies in the urine of fasting rats fed sodium butyrate is similar to that when the next lower homologue of sorbic acid, namely crotonic acid, is given. Moreover, the amount of ketone bodies formed from these 2 acids is the same. Although LD_{50} tests and acute feeding tests on 2 species have demonstrated the innocuousness of sorbic acid, we feel that the strongest argument for the harmlessness of this substance is the proof of identity of its pattern of oxidation with that of naturally-occurring fatty acids, both *in vitro* and *in vivo*.

We can say categorically that the results of the metabolic tests have application in the case of man. On the basis of previous work, it is possible to relate the condition of exogenous ketonuria in the rat to fasting ketonuria in man. Thus, in both species, an exogenous source of fatty acids will increase the extent of ketonuria. In the second place, both types of ketonuria are abolished by the concomitant ingestion of metabolizable carbohydrate. Thirdly, the markedly higher level of fasting ketonuria in women as compared with that in men *(11)* is also exhibited in the exogenous ketonuria of both the rat and the guinea pig *(4)*. Finally, the greater ketolytic action of galactose over glucose, which was first demonstrated in man *(12)*, has been shown to occur in rats in which the experimental procedure of exogenous ketonuria was used *(3)*. The identity of the metabolism of sorbic acid and caproic acid, as demonstrated by experiments on rats, must certainly also be true for the human. When any investigation employing the metabolic approach can be shown to apply to man, it will obviously have much greater significance in establishing the basis for the decision as to whether or not such a compound should be permitted as a food additive.

There are many substances the toxicity of which may be investigated in a similar manner. In the study of any possible deleterious action of vitamin D-like compounds, the effect on calcium deposition should be used as a tool. In the case of vitamin E, a satisfactory index would be the effect of the substance in question on reproduction. Blood clotting can well be the physiological index in the investigation of the effectiveness and safety of vitamin K-active compounds.

CONCLUSION

In conclusion, I should like to emphasize that, in cases in which a biological and a metabolic approach are possible, the proof of harmlessness of a food additive can be established more quickly, more cheaply, and on a more sound scientific basis than is possible with the present toxicological approach. However, in the case of a large number of substances, in which neither the chemical nature nor the metabolic pathway is known, one will probably be forced to continue to employ the present method of testing. Moreover, even in cases in which a satisfactory metabolic approach is feasible, one should continue to determine the LD_{50} value and to determine any acute effect of large doses on growth. Finally, the increased use of the metabolic approach does not relieve the investigator from establishing proof of the identity of the product being tested.

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The Attitude of Medical Men Toward Chemical Additions to Food[a]

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(Manuscript received June 16, 1953)

The natural interest of a physician in the chemical additions to food is a concern about safety for the consumer. A primary question to be asked is, why should there be any added chemicals? Perhaps the first such additions were used to alter taste or color. Subsequently, we are aware of the attempts to preserve food by using common salt, sugar, vinegar, and also alcohol must be included in this group. Our "scientific" ventures into the employment of synthetic compounds, beginning with boric and benzoic acids, more recently ascorbic acid, are merely extensions of this general activity. The refining of cereals in order to obtain keeping quality has led to the much cherished fineness of texture, associated with white color, in wheat flour, but accompanying this has been ultimately a recognition of a nutritional deficit in the flour. From this special sequence has arisen the more recent urgent effort to restore the lost vitamins to flour and to cereal products in general. Students of nutrition have proceeded rather quickly from this restoration to a concept that is spoken of as enrichment, or fortification. By somewhat different routes, we have arrived at the procedure for fortifying milk with vitamin D, in order to prevent rickets, and with vitamin A, especially in low-cost oleomargarine, in order to give this product a nutritional value more nearly that of the butter which many people have not been able to afford.

In our modern and increasingly complicated pattern, where we use packaged, preserved, and sophisticated foods, there have been apparent advantages from still further chemical additions. Mention may be made of those surface tension reducing agents, bread softeners, bleaching agents, antioxidants, and an ever-expanding group of synthetic substances. We may well face this problem as an enduring one, for it is apparent that we shall have more and more sophistication of foods and get farther and farther away from the use of natural foodstuffs which were traditional in supporting the nutrition of the human race.

In those cases where human usage has extended through centuries, one is not inclined to require a laboratory study of each and every such procedure, including the use of salt, the natural fermentation acids or alcohols, or sugar. But it seems increasingly to be reasonable that we ask for the most thorough study of any additive which does not have a background of extensive human use. Not until safety has been proved in a positive fashion by the use of biological testing should the medical profession give its sanction to a proposed addition to known foods.

In preparing this discussion, I have found some exceptionally able statements of the problem and the steps recommended from the pen of Professor A. C. Frazer, Chairman of the Department of Pharmacology at Birmingham, England, and I am happy to be able to quote verbatim, with his express consent. I venture to offer these extensive quotations from journals that are not frequently consulted by people in the United States in order to make them more readily available. Professor Frazer wrote in *Chemistry and Industry* for 1952 *(1)*, as follows:

> There are always those who long for the return of the "good old days." The most extreme back-to-nature enthusiasts would have us eat our daily food unprepared, unprocessed and uncooked. They would, presumably, prefer us to discard all the changes introduced into our environment during the last few hundred years, on the erroneous supposition that earlier generations were more healthy than our own. The sudden change in our environment that they advocate would certainly be detrimental to the health of, if not actually fatal to, most of us. A more moderate section of this group put forward a more insidious argument. They contend that substances of natural origin are inherently safer to eat than synthetic chemicals. This view is not supported by the facts. It is argued that since we have eaten certain things for generations, these substances cannot be harmful. However, people have been dying from various diseases, the cause of which is still quite unknown, throughout that period. There is absolutely no guarantee that some of the components in our diet may not aggravate or even cause certain disease conditions. There is, in fact, evidence to show that the natural constituents of the diet may lead in some cases to disease and perhaps to more rapid aging and earlier death. There is a considerable body of evidence, for example, to indicate that cholesterol-containing foods may have an influence on arterial degeneration. Thus, the consumption of particular dietary constituents may have as a result, at least for some people, a shortened life span. There is no doubt at all that proteins may give rise to alarming signs and symptoms in certain subjects who are said to be allergic to these particular foods. Rancid fats, which are a natural product, can kill rats in a few days; at lower dosages they can cause severe gastro-intestinal disturbance. It is not impossible that they may play some part in the actiology of tropical sprue *(6)*. Recently it has been shown by Dicke *(2)* that wheat flour, whether agenized or not, may cause a marked aggravation in the condition of children with the so-called "coeliac syndrome." In all these cases natural food materials consumed for centuries can be shown to give rise to some deterioration in health. It is not impossible that the elimination of some unknown substance "x" from the diet might profoundly affect public health and significantly increase the normal expectation of life. It should also be remembered that most potent organic poisons are natural substances and that all the recorded outbreaks of food poisoning, other than those due to inorganic compounds, have had a natural origin. There is, therefore, no sound basis for the claim that natural substances are inherently safer than synthetic materials. When taken out of their normal dietary context and used as food additives, natural substances should be subjected to the same rigorous examination as is demanded for synthetic chemicals.

ESTABLISHING THE MARGIN OF SAFETY

As a very recent example of the necessity for reexamining the safety of a natural product long in use, attention is directed to the announcement made May 22, 1953, by the United States Food and Drug Adminis-

[a] Presented at the Thirteenth Annual Meeting of the Institute of Food Technologists, June 23, 1953, Boston, Massachusetts.

tration that producers of coumarin had decided to withdraw this flavoring agent from sale for use in food. This was done because pharmacological studies had led to raising the question involving the safety of the substance when used as a flavoring in foods. Coumarin, which is a naturally-occurring flavoring material widely used, can also be made synthetically. The case cited illustrates the necessity for giving consideration to both natural and synthetic materials, and for reconsidering time-honored practices in the light of more recent knowledge.

May I quote Dr. Frazer further, from a recent paper in *Endeavour (3)*:

> The addition of either natural or synthetic chemicals to food carries a potential risk to the consumer if the pharmacological action of the substance in this dietary context is not known. Synthetic chemicals are no more likely to be toxic than natural substances—indeed, many of the most potent poisons known are of natural origin. Substances that have been consumed as food for centuries are not necessarily harmless, since millions of people have died from unknown causes over the same period. In fact, there is ample evidence to indicate that certain foods can cause harmful effects. Some people are allergic to particular articles of diet, and may develop alarming symptoms after eating them even in small quantities. Wheat-gluten has recently been shown to be deleterious to children with coeliac disease *(1, 9)*. Dietary characteristics may account, at least in part, for differences in the incidence of such conditions as cirrhosis of the liver *(7)* and atherosclerosis *(8)*. Thus, many natural constituents of the diet may have harmful potentialities. The diet must be regarded as a part of the environment of man, and one of the factors that may determine the life-span of the individual. The problems of chemicals in food fall into their proper perspective when examined against this broader background.
>
> The direct or indirect effects of any food additives on biological systems may be adequately assessed by the application of appropriate pharmacological methods, based on adequate knowledge of the biochemical properties of the substance under test, and a full appreciation of the nutritional implications *(5)*. The substance under investigation must be characterized chemically and the standard of purity specified. . . . The chemical and physical properties may clearly indicate certain likely toxic effects, but this is mainly of academic interest, since any action of the substance, predictable or otherwise, can be determined by normal pharmacological methods. Any significant response observed should be quantitatively related to the effective dosage level; the dose required to cause any particular effect in 50% of a group of experimental animals is termed E.D. 50.
>
> The importance of relating pharmacological effects to dosage cannot be over-emphasized. Dosage levels of all chemical substances can be roughly classified, from a pharmacological point of view, as ineffective, effective, toxic, and lethal. With most common drugs, the general ratio of ineffective, effective, toxic, and lethal dosage in man is not greater than 1 : 10 : 100 : 1000. Thus, the therapeutic dose of atropine for an adult of about 70 kg. bodyweight is of the order of 1 mg., the toxic dose is 10 mg., and a likely fatal dose 100 mg. The administration of 0.1 mg. to an adult man is unlikely to cause any demonstrable effects. Similar relationships are found in the case of arsenic, the therapeutic dose of which is of the order of 5 mg., the toxic dose about 50 mg., and a likely fatal dose about 500 mg. An ineffective level of dosage is 0.5 mg., and this is the same order of dosage that may result from the ingestion of arsenic in food within the accepted limits of tolerance. Dosage has a direct relationship to bodyweight. Thus, other things being equal, the same effect will be produced in an infant of six months weighing 7 kg. by one-tenth of the dose that is effective in an adult man of 70 kg. Consequently, the consumption of one-tenth of an ineffective adult dose by a six-months-old infant does not bring the dosage level outside the ineffective range.
>
> This question of dose-response relationships is vitally important in deciding both the design and the interpretation of the pharmacological studies. In the study of therapeutic agents it is important to define the effective level, but in the study of food additives attention must be directed to the establishment of the ineffective dosage level and the provision of an adequate margin of safety for this estimate. Food additives may cause no demonstrable effects in experimental animals, even when administered in a dose of 1 g. per kg. body-weight. Substances with an ineffective dosage level of this order are usually regarded as non-toxic. With food additives, it is necessary to relate dosage levels to the daily intake of the substance. This quantity may be termed the standard dietary dose, and should take into account any likely variation in quantities used. The question now arises of the level at which feeding-tests should be carried out. It has been agreed on a more or less arbitrary basis that food additives should be tested at various dosage levels up to 100 times the standard dietary dose. It has not been clear, however, how the results of such tests should be interpreted; some authorities demand that no effects should result from the hundredfold test-dose, while others have not accepted substances that conform even to this rigorous criterion, and still others have suggested that substances should be rejected on the basis of invisible and undemonstrable changes that may have occurred. This last view denies the whole basis of observational and experimental science, and clearly makes any form of biological testing futile. If the general question of dose-response relationships is considered, the results of the investigation of any substance at ten times and a hundred times the standard dietary dose can be reasonably interpreted. If the substance causes no effects at the tenfold dosage, and significant effects in less than 50% of the experimental animals at the hundredfold dosage, the standard dietary dose should be regarded as acceptable, since it is clearly less than one-tenth of the ineffective dose and one-hundredth of the E.D. 50, with regard to any significant action of the substance under test. Should any significant effect of the substance be demonstrated at the tenfold dosage, or in more than 50% of the animals at the hundredfold level (nutritional and palatability effects being excluded) the E.D. 50 should be estimated, and from this the appropriate level of acceptance can be calculated. . . . As already mentioned, most of the food additives have been found to be essentially non-toxic, so that the dosage levels usefully studied do not go further than the effective dose. If substances should have to be considered which give toxic or lethal effects at doses of less than 1 g. per kg. body-weight, a detailed study of the dose-response relationships of the particular substance under test would be advisable.
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> The possible effects of the food additive must be studied in both short-term and long-term experiments. This is readily achieved by carrying the feeding experiments through several generations, and examining the effects throughout the life-span of the animal. If there is any indication that cumulation might occur, the maximum weight of the substance eliminated in 24 hours should be determined. From these data, the non-cumulative dosage level can be accurately assessed, provided that the organs responsible for elimination are not damaged by the substance, and that this eventuality has already been guarded against by the toxicity tests.
>
> Finally, the studies must be made in several different species of animal. True species-specificity with regard to the action of chemical substances is not common, although considerable differences may occur in the effective dosage level in relation to body-weight. Results observed in experimental animals are generally applicable to man. It is wise, however, to carry out a test in human subjects after non-toxicity has been established in animals, to exclude any unexpected species-specific effect.
>
> There can be no objection to this, provided, of course, that adequate preliminary tests have been carried out in

> animals with satisfactory results. There are only two alternatives: either general distribution is made under uncontrollable conditions to the public at large on the basis of animal experiments, in the hope that the species differences involved are not significant; or controlled experiments can be transferred to a group of human subjects under proper supervision and observation before distribution to the public. There can be no doubt as to which is the safer, the wiser, and the more desirable procedure *(4, 5)*.

I have quoted Professor Frazer so extensively because he has expressed these matters extremely well, and I see no reason to take any exception to the statements that I have reproduced.

It will be apparent that special standards of toxicity are essentially more rigorous when applied to the food problems than in the case of drugs. This is because foods are not taken under professional supervision, in most cases, because they are not subject to any kind of uniform and controlled dosage, but are used over a period of many years by the same individuals. Also, foods may be used by those who are young or old, large or small, well or ill. It will be easily understood that the cumulative or chronic effects of the use of any substance added to food are of the greatest importance.

Brief mention needs to be made again of the striking tendency in modern usage for replacement of simple, natural foods by highly sophisticated food products. The problems presented are numerous. One of the very important ones is the nutritional handicap which is imposed by the possible elimination from a food intake of vitally important substances, whether vitamins, proteins, fatty acids, or minerals. While this may not appear to be the same problem as that of chemical additives to food, it is a problem in human nutrition which must be considered when the change in foods may easily alter the proportion of fundamental nutriments used by significant numbers of people. This is, in some senses, a negative counterpart of the chemical additions. Obviously the food industry must be concerned with this, as well.

CONCLUSION

Finally, it should be pointed out that in decisions made about normal foods for healthy people it is not fair to decide on intolerance for a given food by patients with such unusual disorders as celiac disease, sprue, or even the more common chronic forms of gastrointestinal disorder such as peptic ulcer and irritable colon. Foods designed particularly for therapeutic use or for use by people who have chronic disorders would have to be considered in a separate category and must obviously meet similar safety standards, in addition to which they may have to meet standards as therapeutic material. Time will not permit discussing this matter further.

In conclusion, may I suggest that there is nothing mysterious or impossible about this whole problem of a high standard of safety for the chemical additions to our food. Intensive and continued exploration in the chemical laboratory, the pharmacological laboratory, and in the clinic will be necessary in order to assure ourselves of the safety of food processing as now practiced, as well as of proposed alterations in the future, and we may well look forward to a sustained program by industry, together with academic laboratories, under the supervision of standards set by Governmental agencies.

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Food Protection[a]

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(Manuscript received June 24, 1953)

Use of chemicals in the production of foods helps to make possible the abundant and varied diet now enjoyed by the American people. However, along with the advantages obtained by the use of chemicals a problem is posed with respect to their effect on the healthfulness and wholesomeness of foods. This problem happens to be highly controversial.

FOOD PROTECTION COMMITTEE

A little over two years ago the Food Protection Committee was organized in the National Research Council to study the problem of additives in foods and to serve as an advisory body with respect to government agencies and the food industry. There are many aspects associated with the problem of food safety and the Food Protection Committee in practice has limited itself to a collection and evaluation of scientific facts. The Committee has taken no action on questions of legislation since these matters do not fall within its assignment. A number of technical problems have been presented to the Committee by members of the industry and by government agencies.

Early in the work of the Committee a distinction was made between incidental and intentional additives, incidental additives being those like insecticides which may remain in or on foods in small traces and the intentional

[a] Presented at the Thirteenth Annual Meeting of the Institute of Food Technologists, Boston, Massachusetts, June 23, 1953.

additives being those which are added to foods for the purpose of improving their quality in a great variety of ways. The problems involved in the use of incidental and intentional additives are very different and for the sake of brevity, this discussion will be confined to the questions arising from the use of intentional additives. Rather than to enumerate in detail the reports which have been released by the Food Protection Committee, I believe it will be more useful to mention 2 conclusions reached by the Committee which are especially significant with respect to the current problem of chemicals in foods. In this paper I am expressing my own opinions; I am not attempting in any way to reflect the views of the Committee. No other member of the Food Protection Committee should be held responsible for these statements.

In December, 1951, the Committee published a comprehensive statement on the use of chemical additives in foods. In this report an attempt was made to appraise the problem. It was felt that a critical and sound appraisal was needed in view of the many extreme statements that were appearing on both sides of the controversy. Perhaps the judgment of the Committee can best be summed up by a quotation from this report. "Contrary to some ideas that have been circulated, reliable food processors have not reduced the nutritional quality of our foods or created inferior products through the use of chemical additives. Likewise, there is no evidence that consumption of foods resulting from the use of new chemicals in crop production or in the processing of foods has created mysterious disease epidemics or endangered the health of people."

Early in its work the Committee also reviewed the data that were available in 1950 on various types of emulsifying agents. A statement was issued in November, 1951, to the effect that there was not then available to the Committee sufficient evidence to assure the safety of emulsifiers for use in foods. The need for sound critical studies was emphasized especially.

Thus it can be seen that the Food Protection Committee has taken an intermediate position. On the one hand, it has contradicted the many exaggerated statements that have appeared concerning the dangers involved in the present use of chemicals in foods. On the other hand, the Committee has clearly recognized that new chemicals, in some instances, are being introduced into food use before they are adequately tested.

One solution that has been proposed for this problem is to require the prior approval of the Food and Drug Administration of any new additives intended for use in foods. Such an amendment has been proposed by Food and Drug and supported by a majority of the Delaney Committee. The key argument in favor of amending the law to require prior approval is the statement that there are over 700 chemicals used in foods of which approximately 276 have not been proven to be safe. This statement has been read into the record and widely publicized. In my opinion, it gives an exaggerated impression of urgency of the problem and is bound to have considerable influence on people who are not fully informed. The only effective way to counteract this statement is to present facts.

NEED FOR FACTS

Many of the chemicals added to foods are used in extremely small amounts and in some cases, are restricted to a few specialized foods of minor importance. For this reason the citation of the total number of additives does not help in the appraisal of the problem. In order to properly evaluate the problem, it will be necessary to know the extent to which chemical additives are used and to know the amount of each that enters into the diet. This information is not yet available and, as one of its major projects, the Food Protection Committee, through a Sub-committee on Food Technology, has undertaken a study of this particular phase of the problem. The food industry is being requested to supply authentic information on the use of additives in major processed foods. Based on food consumption surveys, a list of approximately 70 processed foods has been drawn up which includes 90% of the quantity of processed foods consumed. It is hoped that food companies, after due consideration, will be willing to provide information on the additives used in foods. A questionnaire is being distributed and it will probably come to the attention of many of you. I hope that you will be inclined to cooperate fully with the important work of this Committee. In any reports of the Committee no mention of brand names will be made or will any individual companies be identified.

There is probably no longer any competitive justification for secrecy with respect to chemical additives in foods. The problem here is very different from other commodities. In the case of food, the public has a stake in obtaining full knowledge of the ingredients in the diet which may have a relation to questions of health and nutrition. Furthermore, many of the major processed foods are covered by standards of identity and complete information on the use of chemical additives in these is already available. In the foods about which we have full information, considerably less than 700 chemical additives are used and there is no indication that any of these present a serious health hazard.

POISONOUS AND DELETERIOUS SUBSTANCES

It should be emphasized that no statements yet released by the Food Protection Committee can be construed as indicating the need for further legislation. Before any such step is taken, very careful consideration should be given to the advantages and disadvantages of the existing law. The present Federal Food, Drug and Cosmetic Act was passed by Congress in 1938 with the primary purpose of preventing the use of harmful ingredients and the practice of fraud. The law thus has 2 main purposes: the protection of public health and the protection of the public pocketbook.

The law specifically prohibits the use of poisonous and deleterious substances except where such substances are necessary in the production of food and cannot be avoided by good manufacturing practices. In such cases of necessity the Food and Drug Commissioner is empowered to establish tolerances limiting to safe levels the quantities of additives remaining in food. Where a poisonous or deleterious substance is not necessary, it cannot be used in any amount regardless of whether it is safe at the level used.

The Food and Drug Administrator not only has the authority to enforce the Act but he also has wide discretionary powers. For example, he can decide which foods to standardize and what ingredients are safe or otherwise suitable for these foods. He can eliminate fluorides in beer but overlook their use in water. He can set stricter requirements for the proof of safety of emulsifying agents than he does for antioxidants and coal tar dyes. He can enforce the labelling requirements in some foods but not in others. He can set the standards for sanitation. The food law has been successful in preventing the use of poisonous and deleterious substances in foods. There are remarkably few cases of illness or death from harmful ingredients in foods.

One major weakness in the law is that it provides no definition of what is meant by poisonous and deleterious substances. The decision, in any given instance, is left to the courts. It is thus very difficult for any one to decide in advance on the basis of toxicity tests whether or not an additive should be considered harmless or poisonous and deleterious. The general practice in

the food industry is to consult with the Food and Drug Administration prior to the introduction of any new additive.

FOOD STANDARDS

Perhaps the most potent provision in the Food and Drug Law is the one which empowers the Food and Drug Commissioner to draw up and promulgate standards of identity for foods when he feels that this will promote honesty and fair dealing in the interest of the consumer. At the present time approximately 150 individual foods have been standardized. Standards are proposed on the basis of public hearings. Although the process is cumbersome and time-consuming, the Food and Drug Administration is proceeding steadily with the standardization of additional foods.

The main feature of food standards, from the standpoint of chemicals, is that no ingredient may be used unless it is specifically mentioned in the Standards. Thus food standards make it possible for the Food and Drug Administrator to prevent the use of any chemical additive which he considers to be of doubtful safety. We have, therefore, a second criterion for safety of food additives. In the case of standardized foods an additive has to be safe enough to convince the Food and Drug Commissioner that it is safe. In this case, also, there is no definition available so that anyone can make an independent judgment on the basis of his own tests nor can any body of experts make such a judgment.

One disadvantage of food standards is that they retard the further development and improvement of foods. The important underlying philosophy of food standards is that it is in the interests of the consumer to give him what he has come to expect. Any change that is novel is naturally unexpected and is discriminated against. For example, it is all right to skim milk because this is a long established practice and the consumer knows about it. However, if it were a new practice, it would be illegal to remove a valuable ingredient from whole milk and to sell a product that might be confused with milk. Similarly oleomargarine, on the grounds that it "purports" to be butter, would be illegal except for the fact that it was developed many years ago.

Another disadvantage of food standards is that they sometimes impose a competitive handicap on individual foods. Everyone knows that margarine is making serious inroads into butter consumption. This is due largely to difference in price and yet the butter industry is not permitted to make any change in butter composition that would make butter less expensive. The fat content is fixed by law at a minimum of 80%. The situation is still more unequal in that margarine manufacturers are allowed to improve their product by adding flavoring agents, emulsifiers, antioxidants, preservatives, and vitamins.

The Government has become our chief cook and has written exclusive menus for some 150 foods. Some of these like spaghetti, catsup, jam, and mayonnaise are unimportant in the consumer's budget. In these cases there is also no serious problem with respect to public health. It may be that we have already proceeded too far along the road of Government regulation. Certainly, this whole problem should be examined before we add further regulations.

CONCLUSION

It is my belief, speaking as an individual, that the remaining problem of food safety can be handled by self-regulation within the industry and full protection could be given to the health of the consuming public without the need of any additional federal legislation. In my opinion the following 3 steps should be taken: (a) The number and scope of toxicity tests should be increased. (b) Full disclosure should be made of the chemical additives used in food and the results of the tests conducted to prove their safety. (c) A list of intentional additives suitable for use in foods should be drawn up and made available to all food companies.

Such a program would be beyond the scope of any single food company and would require the cooperation of the entire industry. I think that the time is opportune for the formation of an industry Board with the assignment of dealing with all problems concerning protection of food safety. Such a Board working closely with Government agencies and with independent scientific groups, such as the Food Protection Committee, would be able to contribute to the interests of the public not only in safety but also in a continuation of technological progress.

Public Education Regarding Chemicals in Food[a]

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(Manuscript received June 24, 1953)

Isn't it a bit surprising that the topic "Public Education Regarding Chemicals in Food" should be a subject of concern to the food and chemical industries? After all, don't we have the most comprehensive system and methods of mass education and information ever developed? Aren't newspapers, magazines, radio, television and multi-million dollar advertising budgets commonplace and available as "vehicles for information?"

Everyone would agree that we are living in a chemical age and that the chemical industry is expanding at a phenomenal rate. The public has given eager acceptance to synthetic fabrics, tires, toys, innumerable household articles, drugs and medicines. Man is justifiably proud of his ability to compete with nature in making these "synthetics;" in fact the public is so chemically minded that the dollar value of man has been appraised based on his chemical content.

With all of this, why has the idea developed in some quarters that the chemical industry is a ruthless ogre with "evil designs on the general gastronomic welfare?"

[a] Presented at the Thirteenth Annual Meeting of the Institute of Food Technologists, Boston, Massachusetts, June 23, 1953.

This atmosphere of unfavorable public relations is especially difficult to understand in view of the excellent record of the industry as a whole in providing honest and safe products with continued efforts and success in quality improvement. It would be safe to say that no nation has ever been better provided with safer, better quality processed foods that are readily available at reasonable prices.

DEFINITIONS AND PRIMARY FACTS

Perhaps a clearer understanding of what is meant by "chemicals in foods" would be helpful. Webster's dictionary defines the word chemical, when used as a noun, as follows: "a substance got by chemical process, or used to produce chemical effect." Strictly speaking the nutritionally important substances, whether isolated from natural sources or synthesized by man, would be chemicals according to this definition. Thus the vitamins, numerous minerals, dextrose, amino acids, et cetera are recognized by practice and experience as substances important in nutrition, therefore their presence in foods is not a debatable issue. What is of concern, however, is the "chemical additives" and the rationale of their usage.

Chemical additives are interpreted to be "chemicals that may be incorporated during the growing or during the storage and processing of food" *(1)*. It has been suggested *(1)*, and it seems rightly so, that the *rationale* of using a chemical additive in a food should be based upon its capacity to improve overall nutritional value, enhance quality and consumer acceptability, result in better food preservation, and increase the availability of the product to the public.

The history of food and drug legislation in this country is the story of attempts to deal with this general question. When Dr. Harvey W. Wiley began his pioneer work, many artificial coloring agents were being added to foods. Their detailed chemistry was not too well known, but they had a rather common property that was widely publicized, namely, that they were found in coal tar, with the implication that everything present in coal tar must be regarded as toxic. Passage of the first food and drug law concentrated attention on this question, and as a result many special investigations were made. Thanks to all of this, we now have a long list of "non-toxic," so-called, certified dyes which food processors may add to their products if they so desire. Similarly, the question of added preservatives received attention. The existing food and drug laws have served both the public and industry well, and under these regulations scientific and technological advances in food processing have provided ever better and more numerous products. With all of these advances, however, come additional and more difficult problems; many new or newly discovered old chemicals have been proposed for use in food products and have received considerable publicity, some of it fair, but some of it also, in our opinion unfair, and really representing the views of impractical extremists.

Any consideration of this problem must recognize that several factors are involved. The first and foremost objective of course is the public's health and safety, for which the food processor who uses chemicals in foods, the manufacturer of the chemicals in question, and the governmental agencies responsible for the administration of the food, drug, and cosmetic act, and the various state and local agencies all bear responsibility. The suggestion has been made that *(2)* "All that we have the right to expect from our laws and our enforcement agencies is that they will provide every reasonable means of protection and security. That the food industry has recognized and discharged the highest responsibility in this respect is borne out by its record of safety." This seems to be a most sensible approach.

It is now time for a little soul searching into some of the reasons for the public's apprehension concerning chemical additives in foods. First of all, there has been too little factual information from the industry itself. The "goings on" in the chemical laboratory have been shrouded by a cloak of mystery, suspicion, and often just plain ignorance. Unfortunately, scientific evidence is not always made readily available soon enough to even the specialized, scientific community through the usual channels of publication. The answer given to this is—"Well, you know we must clear everything with our patent attorneys—everything is top-secret." Secondly, members of the food and chemical industry have stimulated adverse public opinion against chemical additives primarily because of the pressure of economics and competitive situations within the industry. Such activities can only retard progress and in the final analysis can do nothing more than jeopardize the goals of technological advance. One must give a credit to the food faddist for creating a feeling of fear and question concerning the use of chemicals in food. Although this group is small in number, they are powerful in effect. Unfortunately again, conflicts within the food and chemical industry concerning some chemical additives have provided high caliber ammunition for the extremist—to the general discredit of all concerned. Finally, one must consider the role of the Food and Drug Administration and its effect both on the public and industry. Certainly no one can have but the highest regard and praise for the most thorough and competent job done by this group, oftentimes operating with too little funds and too few people, considering the immensity of their task. Many have, however, questioned, as has been stated, "the wisdom of combining judicial, legislative, and executive functions in a single agency." Further, one cannot help but pause to think with much concern when it takes several years, and endless argument in which scientists themselves cannot agree, as indicated by the accumulation of volume of words, to define what a loaf of bread should be. Does this benefit the public, the industry, or the Government? Why should the Government, through its rigid standards of definition, attempt to become as someone has stated the "culinary chef of the nation"? Again, however, industry itself must accept most of the responsibility for these time-consuming argumentative hearings, which generally end up to the dissatisfaction of nearly everyone concerned. If it takes all of this time, effort and money to decide what a certain food should contain, is it any wonder that the general public is suspicious, questioning, and insecure about the general concept of additives? It seems high time for a reasonable solution of the problem: We cannot help but agree and endorse the statement *(2)* "that the gathering of scientific evidence as a basis for 'finding of fact' would be more efficiently and more expeditiously handled by round-table discussion of qualified scientists than by the legalistic procedure now in effect." Certainly a step in this direction has been taken by the establishment of a Food Protection committee under the auspices of the Food and Nutrition Board of the National Research Council.

It is unfortunately true that we have and will probably always have among us, people who simply will not believe that the food and chemical industry are just as interested in avoiding the use of harmful substances as they are. The nub of the matter is the question: are the substances in question safe? What are the scientific facts about them? Have any tests been made? How impartially have the results been evaluated? *et cetera, et cetera.* It is certainly beyond the scope of this paper to discuss problems of toxicity, hazards, or the criteria for use and safety of chemicals in foods. It is fair to say, however, that a suitable climate has not been established in which a fair and sensible public opinion can be developed; one in which the several parties concerned can function not as hostile factions, but in overall harmony, so that the whole problem of chemicals in foods can be placed on an intelligent, reasonable basis.

Education has been defined as "the impartation or acquisition of knowledge, skill, or development of character, as by study or discipline." The public is the community at large. Our problem then is to provide and impart information in such a way that it can be acquired or grasped and appreciated by the community at large. This is a difficult task and the following suggestions are offered for your consideration and discussion.

PROPOSAL FOR AN IMPARTIAL ORGANIZATION TO PROMOTE UNDERSTANDING

It might be helpful first to establish a National Foundation of Food Technology supported jointly by the food and chemical industry, but operated as a separate, impartial, and independent organization, directed by a scientific director and governed by representative members of the industries, the public, the universities,

churches, and Government. Since it is axiomatic that the truth is best told by an honest presentation of the facts, it would be the first obligation of the Foundation to marshal these facts about chemicals in foods, about the service of the food and chemical industry to the public, and about the programs of research and testing concerning chemicals in foods. This organization might well be responsible for the development of news releases, magazine articles and we would hope some supervisory approval of advertising of all kinds with regard to misleading, expansive claims or statements. The philosophy that, he is best governed who is concerned enough to govern himself seems like an ideal policy.

It would seem desirable to utilize the objective services of the scientific board of the Foundation in cooperation with the responsible governmental agencies to review the newly developed products and evidence concerning their safety so as to save time, work, and money for all concerned. The conclusions reached should then be made available to the public in a factual, understandable form. One of the most difficult problems, that of controversy between members of the industrial group, again might best be handled fairly and objectively by the Foundation. While this may sound Utopian, it would certainly be better than airing the issue through years of government hearings in which the credibility and competence of scientific witnesses even on many irrelevant matters become hopelessly entangled in legal mumbo-jumbo—all of which leaves the public very confused and suspicious, and I might add leaves many fine scientists bitter, frustrated and unfriendly toward each other. We would hope that the concept of cooperative reason might save the day for our Utopia.

It would seem reasonable to have the Foundation serve the function of planning, placing, and supervising much of the scientific research concerning chemicals in food—particularly on fundamental problems. Much of this work might be carried out in interested and competent university laboratories.

It would be hoped also that a far reaching plan would be developed for fellowship assistance "with no strings attached" to universities for the development of promising students. All of this would of course not prevent any member organization of the Foundation conducting their own independent program of research as they see fit.

It would seem that the establishment of such a foundation might be the finest way for the members of the food and chemical industries to express their faith and confidence in each other, with the realization that "chemicals in food" is an important industry-wide problem and not one that affects just an isolated few. By such cooperation between industry, government, and the general public, a spirit of understanding can develop which will provide an atmosphere for advance and development, and not strangulation and stagnation.

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Obesity as a Clinical Problem[a]

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(Manuscript received June 13, 1953)

Recognition of obesity as a serious clinical problem has been one of slow development. A decade or two ago hardly any physician recognized obesity as anything more than a personal problem involving only vanity and the dictates of fashion. It was often considered as hardly worthy of the attention of a serious internist, but only as a field suitable for quacks, faddists or for those physicians with fringe ethical standards. Outstanding exceptions to this general opinion were a small group of actuarial experts and diabetes specialists who knew that the obese carried very serious health hazards. One may add to this small group many surgeons who often refused to do elective surgery on very obese persons because of the technical difficulties and operative risks involved.

There is no need to detail how and why the "crude death rate" has declined from 17.2 deaths per 1,000 population in 1900 to 9.7 in 1949; and how and why "life expectancy at birth" has increased from 47.3 years in 1900 to 67.6 in 1949, a spectacular increase of 20 years *(1)*; how and why the proportion of the entire population dying before age 45 has fallen from 38% in 1900 to 10% in 1951 *(3)*. This means that 90% of the present population will live to and beyond age 45. This record of health achievement justifies the characterization of this period as "man's greatest half century *(1)*."

However these advances by producing an older population, has of itself created new problems, such as arteriosclerosis and all of its manifestations, cancer, arthritis and mental diseases.

During this same half century obesity has in all probability increased in frequency; how much no one knows for sure as there are no good data on the prevalence of obesity in 1900, or thereabouts, or for that matter, today. That it has increased in prevalence is probable by deduction. For example the per caput consumption of calories in food has, for practical purposes, remained almost constant at around 3100 calories a day since 1900 *(7)*. During this period the population age 45 and over has increased from 17.8% of the whole to 28.4% *(4)*. This fact alone should have reduced our per caput food consumption, because our need for calories decreases about 7.5% for each 10 years after age 25 *(8, 10)*. Furthermore there has been a significant

[a] Presented before the Thirteenth Annual Meeting of the Institute of Food Technologists, June 22, 1953 at Boston, Mass.

decrease in average energy expenditure since 1900 because of easier transportation and labor saving devices on our farms and in our factories and homes during this period. This latter saving in energy expenditure may be estimated as a minimum of 5% while the decrease in energy expenditure because of the increasing age of the population would approximate about 2.5%. So if 3100 calories was the correct energy requirement in 1900 then 230 calories less, or 2870 calories per caput population would be a comparable maximum now for an older and less hard working population. At 3100 calories we are now either wasting more food than in 1900 or obesity is more prevalent. I suspect that obesity is more prevalent. The recent study of Jean Downes *(2)* of about 18,000 persons 20 or more years of age residing in 34 city blocks in the Eastern Health District of Baltimore shows the prevalence of 10% or more overweight to be actually much larger than the 25 to 28% often quoted. Among males, in the 20-24 year age group the prevalence was 30% increasing to 55% between ages 35 and 54, decreasing to 42% with the 65 plus age group. Among females the prevalence is higher at every age starting at 32.5% in the 20-24 age group and reaching 80% between ages 45 and 54, and then decreasing to 60% in the 65 plus age group. Not only are the females more frequently overweight but they showed a higher prevalence of excessive overweight; that is, 30% or more above the standards used.

If these findings for Baltimore hold for the entire country the problem of overweight is even a greater one than previously reported. This same study confirmed previous clinical judgments and life insurance figures in that heart disease, hypertension, vascular diseases, arthritis, diabetes and gall bladder disease, were significantly associated with overweight.

FUNDAMENTAL INFORMATION ON OBESITY

Although the cause of arteriosclerosis is unknown one fact stands out with clarity: it is that deaths from arteriosclerosis and the degenerative diseases occur earlier in the overweight than in the non-obese population *(5)*. An excess mortality of 50% for the significantly obese would be a reasonable estimate. It is equally clear at the present time that about the only advice the medical profession can offer with confidence to the public in regard to the prevention of arteriosclerosis and its diseases is "never become overweight, and if overweight, reduce and stay reduced." Among these important public health problems of arteriosclerosis and cancer, obesity as pointed out by Henry Sebrell *(11)* is unique in that it can be controlled without further research into its fundamental nature. This fundamental information that the clinician can use in treating obesity may be summarized as follows:

Obesity is invariably caused by a greater intake of calories in food than expenditure of calories as energy. This fact is important. In its treatment it prevents the doctor and the patient from searching for another cause for the obesity. All too often, as a concession to conservatism, we see such statements as "Obesity is nearly always caused by overeating" or in "9 out of 10 subjects obesity is caused by overeating." Such statements actually give the obese person a reason for not blaming his obesity upon his own gluttony. They are often, in their own mind at least, *the exception* to the rule. This fact leads us to the next dictum.

The essential component of every reducing regimen is a "calorie deficit" (9). By metabolic studies the loss of adipose tissue over a period of time, in an obese person maintained on a sub-calorie diet, otherwise adequate, has been shown to be directly proportional to the calorie deficit. This loss of adipose tissue can be predicted with remarkable accuracy. These metabolic calculations are based on the fact that 1 g. of adipose tissue yields an average of 7.7 calories, one pound of adipose tissue yields 3500 calories and 1 kg. yields 7700 calories. Therefore, a deficit of about 3500 calories leads to the metabolism of a pound of adipose tissue, and a deficit of about 7700 calories leads to the metabolism of 1 kg. of adipose tissue. This is true whether the calorie defict is acquired over one day, one week, one month, or for that matter, one year. It is therefore possible, when the calorie deficit is known, to predict with remarkable accuracy the loss of adipose tissue over a period of time *(5)*. To do this it is necessary to determine the basal energy requirement by the Boothby and Berkson Food Nomogram *(6)*. The initial weight at the beginning of each 25 pound decrement in weight is used for the calculation. To the basal calorie requirement a percentage correction is added or subtracted if the basal metabolic rate is above 15% or below minus 15%. No correction is made if the basal metabolic rate is between these figures or if it is unknown. To the basal calorie requirement is added 20 to 70% (usually 40 or 50%) according to Table 1 to cover the calories required for activity. The resulting figure represents the estimated daily calorie expenditure.

An easier way, especially applicable for laymen or for those who get frightened by a nomogram is to refer to tables of Predicted Daily Calorie Needs (Tables 2 and 3) for persons of

TABLE 1

Percent increase to be added to basal calories to obtain daily calorie expenditure [b]

20% for people at "house" or "bed rest." This figure is used when the person is confined to bed, a room chair or a wheel chair, as following a fracture of the leg, a crippling type of arthritis, a "stroke" or paralysis, heart disease, and in early convalescence from an illness.

30% for people at moderately restricted activity but who are up and about. This generally includes people in late convalescence when not confined to the house but who are permitted to sit on the lawn, take short motor trips, take short walks or be a sport spectator. This group also includes most retired elderly people who voluntarily or on doctors' orders restrict physical activity to the minimum sufficient to prevent boredom.

40% for people with slightly restricted activity. The largest group here are housewives who neither do their own housework nor engage in gainful outside work.

50% for people in the following light or home occupations—the white-collar occupations, machinery operators, housewives who do their own work, domestic servants, chauffeurs and similar workers.

60% for people who are moderately heavy workers, such as manual laborers, farmers, truck drivers and expressmen. This also applies to most adolescent children who are obese.

70 to 100% for people who are engaged in heavy work, such as stevedores, lumberjacks, steel workers and such.

[b] By permission.

TABLE 2

Average [c] energy requirement [d] for women of normal weight [e]

Height	Age group						
	15–19	20–29	30–39	40–49	50–59	60–69	70–79
4' 9"	2080	1890	1810	1760	1710	1480	1370
4' 10"	2110	1920	1840	1790	1740	1510	1400
4' 11"	2140	1950	1870	1820	1770	1530	1430
5' 0"	2190	1980	1900	1850	1800	1550	1450
5' 1"	2240	2020	1940	1890	1850	1590	1480
5' 2"	2290	2060	1980	1950	1900	1640	1510
5' 3"	2350	2100	2030	2000	1950	1690	1550
5' 4"	2400	2150	2080	2040	2000	1740	1590
5' 5"	2460	2200	2140	2080	2050	1780	1640
5' 6"	2520	2250	2190	2120	2100	1820	1690
5' 7"	2570	2300	2240	2160	2150	1860	1730
5' 8"	2620	2350	2290	2220	2200	1910	1770
5' 9"	2680	2400	2340	2260	2250	1950	1800
5' 10"	2740	2450	2400	2310	2300	1990	1830
5' 11"	2800	2500	2450	2360	2350	2040	1880
6' 0"	2860	2550	2500	2410	2400	2090	1930

[c] For overweight persons add 4 calories for each pound over the ideal weight.

[d] These figures are calculated from the normal basal energy requirements with an allowance for activity of 60% for the 15-19 age group; 50% for ages 20 to 59; and 40% for ages 60 and over. These figures apply for most overweight housewives who do their own housework, for clerical and office workers, machinery operators, domestic workers and similar occupations. People engaging in the heavier occupations require 10-20% more and people who are retired or engage in little or no activity require about 10% less.

[e] Published in *Quarterly Bulletin*, New York City Department of Health, Vol. XX, Summer, 1952, No. 2.

TABLE 3

Average [a] energy requirement [c] for men of normal weight [b]

Height	Age group						
	15–19	20–29	30–39	40–49	50–59	60–69	70–79
5' 0"	2620	2250	2100	2020	1980	1710	1570
5' 1"	2690	2310	2160	2070	2020	1750	1610
5' 2"	2750	2390	2220	2110	2070	1790	1650
5' 3"	2820	2450	2280	2160	2110	1830	1690
5' 4"	2880	2500	2340	2200	2160	1880	1740
5' 5"	2940	2560	2400	2260	2200	1920	1780
5' 6"	3000	2620	2460	2320	2250	1950	1790
5' 7"	3070	2680	2520	2380	2310	2000	1850
5' 8"	3140	2740	2580	2440	2370	2060	1900
5' 9"	3200	2800	2640	2500	2430	2100	1930
5' 10"	3280	2880	2710	2560	2490	2160	1990
5' 11"	3360	2950	2790	2620	2550	2210	2040
6' 0"	3440	3030	2860	2680	2610	2250	2070
6' 1"	3520	3130	2940	2740	2670	2310	2130
6' 2"	3600	3180	3010	2800	2730	2370	2180
6' 3"	3680	3250	3090	2860	2790	2410	2220

[a] For overweight persons add 4 calories for each pound over the ideal weight.

[c] These figures are calculated from the normal basal energy requirements with an allowance for activity of 60% for the 15 to 19 age group; 50% for ages 20 to 59; and 40% for ages 60 and over. These figures apply for most overweight men who are engaged in white collar occupations, machinery operators, chauffeurs and similar occupations. People engaging in heavier occupations require 10 to 20% more, and people who are retired or engaged in little or no activity require about 10% less.

[b] Published in *Quarterly Bulletin*, New York City Department of Health, Vol. XX, Summer, 1952, No. 2.

normal weight at different heights, ages, and sex. To these figures may be added 4 calories for each pound of overweight and thus a figure for average calorie expenditure will be obtained not far different than that obtained from the nomogram.

The difference between the estimated daily caloric expenditure and the prescribed calorie intake derived from a low calorie diet, is the "calorie deficit." This figure multiplied by the factor 0.002 [1] will give the predicted loss of weight per week in pounds, when calculated on a minimum of 4 weeks' time and a maximum loss of weight of 25 pounds. A 10 weeks' period for convenience is usually taken.

All methods of reducing the obese of excess fat are effective only insofar as they aid in producing and maintaining a caloric deficit. A calorie deficit can be obtained either by increasing the calorie expenditure or by decreasing the caloric intake, or by both methods. There is an exaggerated idea of the value of exercise in producing a calorie deficit. For the average person a walk of one mile at the rate of 2 miles per hour leads to the expenditure of 100 extra calories. Therefore, to lose 2 pounds of adipose tissue by this type of exercise alone, the average person would have to walk 10 extra miles each day for one week without increasing the food intake. This is difficult because exercise usually increases the appetite. Therefore a considerable and sustained increase in calorie expenditure by exercise for most obese persons is impractical. On the other hand to lose 2 pounds of adipose tissue by diet while maintaining the same caloric expenditure—that is, without additional exercise—the obese person needs to eat daily for one week 1000 calories less than the caloric expenditure. For most obese persons this is easier than the equivalent amount of exercise and does not require daily 5 extra hours of walking. Therefore, most effective reducing plans are based on the production of a calorie deficit by a reduction of calorie intake below calorie expenditure without as a rule simultaneously increasing the calorie expenditure.

Adjuvants to the low calorie diet, whether medicinal, physical, psychologic or educational, are valuable only insofar as they increase the calorie expenditure or aid the patient in control of appetite so as to adhere to the prescribed diet.

The reducing diet should form the basis of dietary re-education so that the proper eating habits will continue after the desired loss of weight has been attained. For this reason skipping meals, uncommon or trick diets, and high fat diets that do not furnish a sound basis for permanent dietary habits are not recommended. Only under special and unusual circumstances and then but temporarily are such expedients used. To re-educate the reducer in proper dietary habits is one of the reasons bread, milk, and a large variety of protein foods, fruit and vegetables should be included in reducing diets. Although no one single food is essential, these foods are all normal ingredients of a well-balanced American diet, and should form the basis of low-calorie diets aimed at both weight reduction and dietary re-education.

CALORIE COUNTING

In this respect I wish to emphasize the education of the patient in elementary dietetics, that is, into calorie counting if you please. A number of people reduce without ever learning food values. This they do by following a rigid menu and never deviating from the prescribed plan. While reducing they are barred from eating many foods which they might eat simply because they know nothing about food values or how to substitute one food for another. They are psychologically barred from eating away from home because the food served may differ from that prescribed at a particular meal. Still more important is the fact that when the desired amount of weight has been lost, it is promptly regained because the reducer has learned nothing of the energy value of foods.

So to gain freedom from rigid, monotonous menus, in order to reduce and stay reduced it is necessary to learn food values in terms of standard portions. With a little practice this can become almost second nature.

[1] The factor 0.002 is derived as follows: One pound of adipose tissue in metabolism yields an average of 3500 calories. The daily calorie deficit multiplied by 7 gives the weekly caloric deficit, which divided by 3500 gives the predicted loss of adipose tissue in pounds for one week, and the equation is: predicted loss of weight per week equals daily calorie deficit × 7/3500. The factor 0.002 is the constant derived from 7/3500 and is substituted for this part of the equation. If the weight loss is to be calculated in kilograms per week the equation becomes: predicted loss of weight per week equals daily calorie deficit × 7/7700, and the constant factor becomes 0.0009.

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Peanut Butter. IV. Determination of Color of Peanut Butter by a Spectral Reflectance Method

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(Manuscript received April 3, 1953)

The colors of twenty peanut butter samples ranging in color from very light to very dark are determined by an application of reflectance spectrophotometry, and are expressed as C. I. E. (I. C. I.) designations, Munsell renotations, and Hunter values. In general, the x-trichromatic coordinate, the redness factor, increases with the amount of roasting accorded the peanuts. The technique affords an objective means of determining the color of peanut butter.

Color is a dominant characteristic in the evaluation of peanut butter. Its importance as an index of quality is illustrated by the fact that in the U. S. Standards for Grades of Peanut Butter *(18)*, 20 of the 100 points of evaluation are allocated to color. Color plays an important part in the sale of food products. The customer frequently bases his selection on an association of generally appetizing characteristics with color, in the case of peanut butter particularly the flavor and aroma developed by roasting. An objective method for determination of color which will afford manufacturers a reliable means of gauging the color of peanut butter and indirectly the quality of the product is considered desirable.

The visual comparison method for color measurement has been the one most widely used. Color plates in the Maerz and Paul *Dictionary of Color (13)* have been used for identifying the color of peanut butter *(19)*, and one of the panels is the standard for comparison in the United States Standards for Grades of Peanut Butter *(18)*. However, these plates are unsatisfactory for evaluating the colors of peanut butters because of the difficulty of finding panels that match the colors of peanut butter and because of the unequal differences in color between neighboring panels on the plates. Munsell notations obtained by the disc colorimeter technique *(15)* provide close matches of color, but here also the final matching is done by the eye. All these methods involving visual comparison are subjective methods and results obtained by them are influenced by the observer's judgment and limitations.

Objective methods have been sought because they produce results which are in no way related to the ability of the observer to remember or match colors, and therefore should permit closer quality control leading to greater uniformity of products.

Methods depending on extraction of pigments with solvents and measurement of the color of the extract with a spectrophotometer or with a photoelectric colorimeter have been found useful for the measurement of color in canned fruits and vegetables *(2, 11, 12)*. The colors of peanut and cottonseed proteins have been evaluated by spectral transmittance measurements of solutions of the proteins in dilute sodium hydroxide *(5)*. For peanut butters produced from peanuts roasted to various extents *(17)*, the C.I.E. (I.C.I.)[b] trichromatic coordinates calculated from spectrophotometric measurements of the sodium hydroxide dispersions were too close numerically to be of value in distinguishing the colors of the peanut butters.[c]

Reflectance spectrophotometry and photoelectric reflectometry provide methods for objective measurement of the colors of opaque products. Methods using these instruments have been applied to the study of color changes in several food products *(3, 4, 7)*. Considerable use has been made of a direct-reading modification of the reflectometer in the measurement of the color of tomato products *(8, 19, 20, 21)*.

This report presents the results obtained on the application of a reflectance spectrophotometric method to the measurement of the colors of variously roasted peanut butters.

EXPERIMENTAL

Samples. The peanut butters used in this investigation were produced from No. 1 grade, shelled white, Spanish peanuts *(16)* obtained from a commercial shelling plant in southeastern United States. Data of Willich, Hall, Morris and Freeman *(19)* have been presented previously regarding the preparation of the peanut butters, and only sufficient information is contained in the present paper to identify the peanut butters.

The peanut butters were arranged in a series from the lightest to the heaviest roast as judged visually by the increasing depth of color. Each sample was given the color designation of the color panel in the Maerz and Paul *Dictionary of Color (13)* which most nearly matched it.

Method. The spectral reflectance technique records the spectral distribution of light reflected from the colored sample. The visual color of any material depends for one thing on the spectral distribution of the light reflected from it. When this is combined with spectral data for the light source assumed for viewing the sample, and for the standard observer assumed to be viewing the sample, this technique provides a measurement of the color. Data obtained spectrophotometrically, when combined with data for the light source and for the observer, may be expressed numerically by several systems of color designation.

Reflectance curves in terms of optical densities over the spectral region range from 300 to 700 mμ were obtained for all of the samples by use of a Cary recording quartz spectrophotometer[d] equipped with a diffuse reflectance attachment. The sample of approximately 35 g. of peanut butter was placed in a shallow glass container, 15-mm. in depth and 50-mm. in diameter, filling it slightly overfull. The excess was struck off even with a straightedge. The sample and container were placed in a holder and clamped firmly in place behind the vertical window of the spectrophotometer. From the curves optical densities were read at 10-mμ intervals and converted to reflectance. For wave

[a] One of the laboratories of the Bureau of Agricultural and Industrial Chemistry, Agricultural Research Administration, U. S. Department of Agriculture.

[b] C.I.E. is the abbreviation for Commission Internationale de l'Éclairage (translated as International Commission on Illumination) adopted at the C.I.E. conference in Stockholm in 1951 in lieu of the initials, I.C.I.

[c] Unpublished data.

[d] The use of trade names in this article is for identification and implies no endorsement of the manufacturer of the product.

lengths above 700 mμ reflectance values were assumed to be constant. Tristimulus values and the trichromatic coordinates x, y, and z were calculated by the weighted ordinate method using data for C.I.E. illuminant C and the C.I.E. standard observer from Table 1 in a paper *(9)* by Kelly, Gibson and Nickerson. The psycho-physical attributes, dominant wave length and excitation purity, were determined by application of the tristimulus value Y and the trichromatic coordinates x and y to Chart No. 7 in the *Handbook of Colorimetry (6)*. Luminous directional reflectance is equivalent to Y multiplied by 100.

Munsell renotations were obtained by application of the C.I.E.-Munsell conversion charts found in a paper *(14)* by Newhall, Nickerson and Judd.

Hunter scale numbers, R_d, a and b were obtained by substituting C.I.E. tristimulus values in equations which relate the scale numbers to C.I.E. data.

Typical reflectance curves for a very lightly roasted peanut butter (C), a medium roasted product (A) and a very dark product (B) are shown in Figure 1.

Calculation of tristimulus values and trichromatic coordinates. The computation of the C.I.E. tristimulus values and trichromatic coordinates by use of coordinates from the optical density curves converted to reflectance and the values for $E_c\bar{x}$, $E_c\bar{y}$, and $E_c\bar{z}$ (tristimulus values for the standard observer for spectrum colors, weighted by the energy distribution of illuminant *C)* taken from the table of the paper by Kelly, Gibson, and Nickerson *(9)* is shown for peanut butter sample No. 9 in Table 1. The coordinates of the curves automatically obtained by use of the recording spectrophotometer are wave lengths (in millimicrons) and optical density. The computation necessitated converting readings for every 10 mμ on the curves from optical density to reflectance. The products $RE_c\bar{x}$, $RE_c\bar{y}$, and $RE_c\bar{z}$ are obtained by multiplying the values for reflectance by the values $E_c\bar{x}$, $E_c\bar{y}$, and $E_c\bar{z}$, respectively. Sume of the products $RE_c\bar{x}$, $RE_c\bar{y}$, and $RE_c\bar{z}$ were obtained and each sum was divided by 100.000 to obtain the C.I.E. tristimulus values X, Y, and Z, respectively. From the tristimulus values the C.I.E. trichromatic coordinates x, y, and z were calculated as indicated in Table 1.

Determination of psycho-physical attributes. Luminous directional reflectance was obtained by multiplying the tristimulus value Y by 100. Using the trichromatic coordinates x and y, dominant wave length and excitation purity were determined from Chart No. 7 in the *Handbook of Colorimetry (5)*.

Conversion of C. I. E. data to Munsell renotations. The Munsell renotation was determined by application of the C.I.E. designation (tristimulus value Y and trichromatic coordinates x and y) to the table and charts found in a paper by Newhall, Nickerson, and Judd *(14)*. For sample No. 9 Table 2 of the reference mentioned gave a *value* of 5.13 and the charts (Figures 5 and 6 of the same reference) gave the following renotations:

Figure No. 5, for Munsell value 5.00/, 9.84 *YR* 5.00/3.96
Figure No. 6, for Munsell value 6.00/, 9.23 *YR* 6.00/4.64

Linear interpolation between these two notations for *value* = 5.13 gives the complete Munsell notation 9.76 *YR* 5.13/4.05 for *hue*, *value*, and *chroma*, respectively.

TABLE 1

Calculation of tristimulus values and trichromatic coordinates for peanut butter No. 9

Wave length	Optical density	Reflectance	$E_c\bar{x}$	$RE_c\bar{x}$	$E_c\bar{y}$	RE_cy	$E_c\bar{z}$	$RE_c\bar{z}$
mμ								
770	.....	0.352	1	0.35	.....	.....	.....	.....
760	.....	0.352	1	0.35	1	0.35	.....	.....
750	.....	0.352	2	0.70	1	0.35	.....	.....
740	.....	0.352	4	1.41	2	0.70	.....	.....
730	.....	0.352	8	2.82	3	1.06	.....	.....
720	.....	0.352	19	6.69	6	2.11	.....	.....
710	.....	0.352	39	13.73	14	4.93	.....	.....
700	0.454	0.352	82	28.86	29	10.21	.....	.....
690	0.460	0.347	171	59.34	62	21.51	.....	.....
680	0.467	0.341	369	128.04	134	46.50	.....	.....
670	0.474	0.336	708	237.89	259	87.02	.....	.....
660	0.487	0.326	1361	443.69	504	164.30	.....	.....
650	0.500	0.316	2349	742.28	886	279.98	.....	.....
640	0.518	0.304	3693	1122.67	1443	438.67	.....	.....
630	0.530	0.295	5309	1566.16	2190	646.05	.....	.....
620	0.548	0.283	7070	2000.81	3153	892.30	2	0.57
610	0.566	0.272	8325	2264.40	4176	1135.87	2	0.54
600	0.574	0.267	8949	2389.38	5316	1419.37	7	1.87
590	0.595	0.254	8984	2281.94	6627	1683.26	10	2.54
580	0.617	0.242	8417	2036.91	7992	1934.06	16	3.87
570	0.643	0.228	7322	1669.42	9147	2085.52	20	4.56
560	0.672	0.213	5880	1252.44	9841	2096.13	39	8.31
550	0.700	0.200	4282	856.40	9832	1966.40	86	17.20
540	0.730	0.186	2785	518.01	9149	1701.71	195	36.27
530	0.763	0.173	1523	263.48	7934	1372.58	388	67.12
520	0.795	0.160	576	92.16	6462	1033.92	712	113.92
510	0.825	0.150	89	13.35	4833	724.95	1520	228.00
500	0.854	0.140	52	7.28	3401	476.14	2864	400.96
490	0.885	0.130	363	47.19	2358	306.54	5274	685.62
480	0.915	0.122	1112	135.66	1618	197.40	9461	1154.24
470	0.945	0.114	2272	259.01	1058	120.61	14972	1706.81
460	0.982	0.104	3362	349.65	694	72.18	19299	2007.10
450	1.015	0.096	3915	375.84	443	42.53	20638	1981.25
440	1.050	0.089	3975	353.78	262	23.32	19938	1774.48
430	1.080	0.083	2997	248.75	122	10.13	14628	1214.12
420	1.113	0.078	1238	96.56	37	2.89	5949	464.02
410	1.145	0.073	329	24.02	9	0.66	1570	114.61
400	1.184	0.066	85	5.61	2	0.13	404	26.66
390	1.230	0.059	19	1.12	.....	.....	89	5.25
380	1.280	0.053	4	0.21	.....	.....	20	1.06
Sums			98041	21898.36	1000000	21002.34	118103	12020.95

$X = 0.21898$ $Y = 0.21002$ $Z = 0.12021$

$S = X + Y + Z = 0.54921$

$x = \frac{X}{S} = \frac{0.21898}{0.54921} = 0.3987$ $y = \frac{Y}{S} = \frac{0.21002}{0.54921} = 0.3824$ $z = \frac{Z}{S} = \frac{0.12021}{0.54921} = 0.2189$

Luminous reflectance, % = 100 Y = 21.00 Dominant wave length, mμ = 582

Excitation purity, % = 41.5

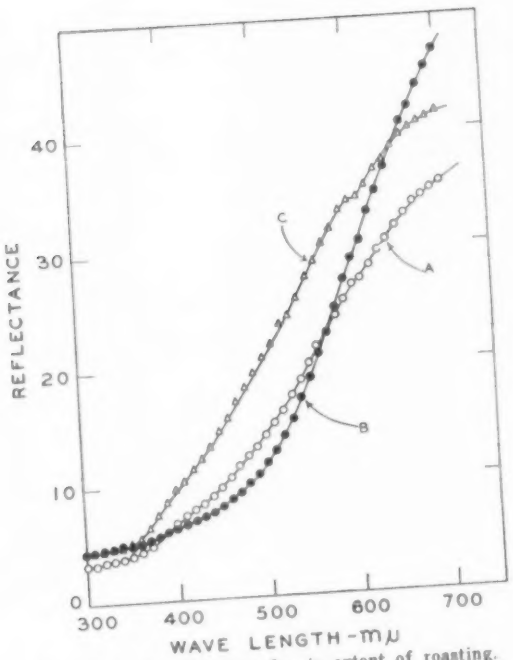

Figure 1. Color changes due to extent of roasting.
A. Peanut butter No. 9.
B. Peanut butter No. 18.
C. Peanut butter No. 3.

Conversion of C.I.E. data to Hunter scale numbers. The Hunter scale numbers were calculated (calculations shown are for sample No. 9) from the C.I.E. tristimulus values by use of the following formulas:

$$R_d = 100(Y) = 100\ (0.21002) = 21.00\%$$

$$a = 175(f_y)\ (1.02X - Y) = 175\ (2.4714)\ (1.02\ [0.21898] - 0.21002) = 5.77$$

$$b = 70(f_y)\ (Y - 0.847Z) = 70\ (2.4714)\ (0.21002 - 0.847\ [0.12021]) = 18.72$$

$$f_y = 0.51\frac{(21 + 20Y)}{(1 + 20Y)} = 0.51\frac{(21 + 20\ [0.21002])}{(1 + 20\ [0.21002])} = 2.4714$$

in which R_d *is the luminous directional reflectance*, a is the *redness-greenness* and b is the *yellowness-blueness* of the sample.

The variation in color of peanut butter with variation in the extent of roasting is shown in Table 2. The tristimulus value Y and the trichromatic coordinates x and y for each sample are shown in the column headed C.I.E. designation. The luminous reflectance, dominant wave length and excitation purity are shown under the heading, psycho-physical attributes. Under the heading Munsell renotations are shown the Munsell *hue*, the Munsell *value*, and the Munsell *chroma*. Luminous reflectance R_d, a, and b shown under the heading, Hunter scale numbers, are values calculated from the C.I.E. data.

RESULTS AND DISCUSSION

It becomes apparent on inspection of the data in Table 2 that there is no particular correlation between luminous directional reflectance and observed color of the peanut butter samples. The darkening of color of the peanut butter samples as the roasting process continues is shown by the spectrophotometric curves to be attributable to a general hyperchromic effect (increase in absorption or decrease in reflection) throughout the entire visible region of the spectra below 600 mμ, and particularly throughout the blue-green and green portions, 400 to 550 mμ. In view of the overall decrease in reflected light as the amount of roasting increases, a decrease in reflectance, *i.e.*, total amount of light reaching the eye, can be predicted. As previously observed, the C.I.E. data in Table 2 confirm this expected decrease in reflectance.

A hyperchromic effect centered mainly in the blue-green and green portions of the spectra, especially with no change in the red portion (above 600 mμ), means that relatively less green light will be reflected to the eye and that the samples will appear increasingly red (the color complementary to green) as the roasting continues. This conclusion is confirmed by visual observation of the peanut butter samples. The increase in absorption between 400 and 550 mμ does not result in any observable absorption bands. Consequently, no great change in purity of the reflected light should be expected. A slight increase in purity should be observed with increase in extent of roasting, because relatively more red light (*i.e.*, less green) is being reflected. Again, as previously pointed out, the C.I.E. data in Table 2 confirm the predicted small increase in purity of the dark samples over the lighter ones.

Increase in the red reflection (*i.e.*, decrease in the green) means that as the roasting continues the dominant wave length of the reflected light will increase (*i.e.*, toward the red). This increase in dominant wave length with extent of roasting is shown in Table 2.

The x-trichromatic coordinate, the redness factor, should from these interpretations of the spectrophotometric curves be expected to increase with increase of extent of roasting. Inspection of the data in Table 2 shows that this is true.

The reflectance spectra of the medium and dark peanut butters were found to exhibit dominant wave lengths within the range of 582-583 mμ and to yield x-trichromatic coordinates not less than 0.40 nor greater than 0.42.

In Munsell renotations *hue* would be the best criterion of acceptable color of peanut butter. The range for the eleven medium and dark peanut butters measured is between 7.1 *YR* and 9.8 *YR* (Table 2). The magnitude of *hue* increases rapidly for underroasted and decreases rapidly for overroasted samples.

In Hunter color and color difference terms the a-coordinate (redness-greenness) is most analogous to the C.I.E. x-trichromatic coordinate, the redness factor. A medium or dark peanut butter is found (Table 2) to have an a-coordinate, with a single exception, between 5.77 and 12.07.

Two objections are often raised to C.I.E. data for color designation: the relatively complex equipment required for obtaining the spectrophotometric data, and the laborious, time-consuming calculations involved in the computation of trichromatic coordinates. Both of these objections can be met with the use of either a recording spectrophotometric equipped with a continuous automatic tristimulus integrator *(1)* or by use of instruments designed for the specific purpose of obtaining tristimulus values *(7, 17)*. The merits of the method are best demonstrated by its use in ceramic, paint, textile, paper and many other chemical industries.

SUMMARY

A method is presented for the objective measurement of color in peanut butter. The method consists of re-

TABLE 2

Variations in color of peanut butter with variation in extent of roasting (data obtained from reflectance spectrophotometric curves)

No.	Peanut butter color		C.I.E. designation			Psycho-physical attributes			Munsell renotations		Hunter scale numbers		
	Type	Designation*	Tristimulus value Y	Trichromatic coordinates x	y	Reflectance	Dominant wave length	Excitation purity	Hue	Value/chroma	Luminous reflectance Rd	a	b
						%	mμ	%			%		
1	very light	11-E3	0.38197	0.3634	0.3704	38.2	577	28.9	12.9YR	6.65/3.1	38.2	0.08	17.70
2	very light	11-J5	0.50647	0.3914	0.3862	50.6	580	40.5	10.7YR	7.50/5.2	50.6	4.26	25.91
3	light	11-G5	0.28154	0.3824	0.3777	28.2	580	35.8	10.9YR	5.83/3.7	28.2	3.28	18.66
4	light	11-G5	0.40930	0.3916	0.3838	40.9	580	40.0	10.5YR	6.67/4.7	40.9	4.71	23.42
5	light	11-G5	0.38869	0.3958	0.3852	38.9	581	41.3	10.0YR	6.70/4.9	38.9	5.46	23.60
6	light	11-G6	0.30442	0.3873	0.3812	30.4	580	38.1	10.8YR	6.03/4.1	30.4	3.76	20.68
7	medium	11-F6	0.42995	0.4051	0.3880	43.0	582	44.7	9.3YR	6.81/5.5	43.0	7.69	25.96
8	medium	11-F6	0.39713	0.4168	0.3898	39.7	583	48.4	8.3YR	6.76/6.2	39.7	10.39	26.60
9	medium	11-F6	0.21002	0.3987	0.3824	21.0	582	41.5	9.8YR	5.13/4.1	21.0	5.77	18.72
10	medium	11-F6	0.36028	0.4162	0.3902	36.0	583	48.3	8.5YR	6.49/5.9	36.0	9.73	25.64
11	dark	11-J7	0.29900	0.4052	0.3864	29.9	582	44.3	9.3YR	5.99/5.0	29.9	7.19	22.40
12	dark	12-K7	0.22522	0.4149	0.3886	22.5	583	47.5	8.8YR	5.29/4.9	22.5	8.29	21.30
13	dark	12-L7	0.21748	0.4164	0.3892	21.7	583	48.1	8.8YR	5.21/4.9	21.7	8.38	21.22
14	dark	12-J7	0.18877	0.4135	0.3870	18.9	583	46.7	8.9YR	4.90/4.5	18.9	7.85	19.70
15	dark	12-I7	0.24685	0.4154	0.3865	24.7	583	47.0	8.4YR	5.51/5.1	24.7	9.26	21.79
16	dark	12-L8	0.21610	0.4215	0.3901	21.6	583	49.7	8.4YR	5.20/5.2	21.6	9.37	21.69
17	dark	12-L8	0.22058	0.4257	0.3841	22.1	585	49.3	7.1YR	5.11/5.3	22.1	12.07	21.47
18	very dark	13-G9	0.20948	0.4299	0.3868	20.9	585	51.1	7.2YR	5.13/5.5	20.9	12.14	21.73
19	very dark	13-F9	0.18485	0.4374	0.3829	18.5	587	52.0	5.9YR	4.73/5.5	18.5	14.34	20.91
20	very dark	13-F9	0.12497	0.4255	0.3756	12.5	587	46.8	6.0YR	4.08/4.3	12.5	11.64	16.52

* Refers to color plates in A. Maerz and M. Rea Paul, *A Dictionary of Color*, 1930, McGraw-Hill Book Company.

cording the spectral reflectance properties of peanut butter directly by use of an automatic recording spectrophotometer equipped with a diffuse reflectance attachment, and expressing the spectral data numerically in terms of the C.I.E. system of color notation. C.I.E. designations are also converted into Munsell renotations and Hunter values.

For comparative purposes a series of peanut butters produced from peanuts roasted to various extents were evaluated by this method. In general, the redness factor was found to increase with the extent of roasting accorded the peanuts, and this can be expressed by the *x*-coordinate, or it can be put into other terms such as dominant wave length, Hunter *a*-coordinate, or Munsell *hue*.

Information obtained in this work establishes that the colors of peanut butters can be measured objectively by reflectance spectrophotometry to yield useful information. This work provides the basis for measurement of the color of peanut butter with less complicated and less expensive equipment by comparison with selected standards which may be prepared from measurements by reflectance spectrophotometry such as these.

Acknowledgments

The authors wish to express their thanks to Dorothy Nickerson, Cotton Branch, Production and Marketing Administration, U. S. Department of Agriculture, for her helpful suggestions and encouragement, and to Henry M. Pearce, Jr. of the Analytical and Physical Division of this Laboratory for assistance in computations.

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The Effect of Bacteria on the Color of Prepackaged Retail Beef Cuts[a,b]

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(Manuscript received April 29, 1953)

The effect of bacteria on the color of prepackaged beef steaks stored under varying conditions was studied. Bacteria commonly found on meats caused discoloration. Meat color was measured objectively by two different methods.

An influence of bacteria on the color of lean of fresh (uncured) meats has been suspected by several investigators. Some *(10, 18, 19)* have stated that bacteria cause color deterioration, but the supporting evidence has been either incomplete or absent. Accordingly, experiments were designed and conducted to measure the effect on color of certain bacteria commonly found on retail meat cuts.

Jensen *(10)* stated that micro-organisms, both living and dead, and their enzymes on the surface of meat may oxidize both fresh and cured meat pigments to methemoglobin, a dark brownish compound. Allen *(1)* stated that there is a type of meat discoloration where a gray-brown color develops when the coloring matter is destroyed by bacteria. Allen *(2)* also reported on the bacterial growth on prepackaged boneless round steaks held at 34° to 40° F. (1.1°-4.4° C.). With counts made every 3 days, a rapid increase in the bacterial population was noted until the ninth day, after which it remained rather constant.

Urbain and Greenwood *(19)* worked with dilute hemoglobin solutions at 50° F. (10° C.). In bacteria-free solutions, no methemoglobin was formed even after 60 days storage, but solutions in which bacteria were allowed to grow showed a decrease of 50% in oxygen capacity, which was attributed to methemoglobin formation.

Kraft and Ayres *(12)* noted that in many instances discoloration of samples was observed before disagreeable odors or other evidences of spoilage became apparent at 40° F. (4.4° C.). In their opinion, however, discoloration was not correlated with organoleptic or microbiological evaluation as a means of determining storage end points. A bacterial count of about 2×10^6 organisms, obtained by swabbing, correlated with the first detectable off-odor.

Ayres *(3)* reported that the level of initial contamination, as well as the temperature of the self-service case, had great influence on the storage life of self-service meats. He also noted the widespread occurrence of *Pseudomonas* type organisms on fresh meats. Sulzbacher *(16)* noted generation times of 4.50 hours in ground beef, and 4.81 and 5.99 hours in ground pork for *Pseudomonas* type organisms at 44.6° F. (7° C.).

Kirsch, Berry, Baldwin, and Foster *(11)* found the great majority of isolates from commercial hamburger meat to be nonpigmented, motile, gram negative, nonspore-forming rods which they classified as *Pseudomonas sp.*

Voegeli, Bratzler, and Mallmann *(21)* made bacterial counts on meats processing equipment and prepackaged retail cuts in 2 self-service retail stores, and found that the store with higher counts on equipment also had higher counts on meats.

Hewitt *(9)* noted that it is commonplace for bacterial cultures to develop reducing conditions, with the lowest oxidation-reduction potential being reached when the metabolic activities of the bacteria are most intense during the logarithmic growth phase.

EXPERIMENTAL PROCEDURE

Boneless beef steaks approximately one-half inch thick were cut from the longissimus dorsi muscle of commercial, good and choice grade cattle. Steaks were wrapped in duPont 300 MSAT-80 cellophane. The experimental surface was covered with one layer only, with excess wrapper folded and sealed on the other side. The wrap was applied with the wettable side to the meat as prescribed by the manufacturer.

Aseptic technique was used in preparation of the steaks. Knives and equipment were washed and then sanitized with chlorine solution, approximately 200 p.p.m., at frequent intervals. Precautions were taken to eliminate direct contact of the sanitizer with the meat. Parke-Davis liquid germicidal detergent was used to sanitize the hands of the operator.

Steaks were paired by assigning surfaces adjacent to one knife cut to control and inoculated treatments. This pairing technique was used to overcome color differences in the same muscle due to variable marbling and other factors.

Bacterial cultures used were obtained from the American Meat Institute Foundation, and had been isolated from commercial retail beef cuts. Five cultures classified by them as *Pseudomonas sp.* were used in exploratory testing, but all gave the same effect on color, so one culture only was used for subsequent inoculation. A 24-hour nutrient broth culture incubated at room temperature (77° F., 25° C.) was used for inoculations. One lot of steaks stored in the cooler at 32° F. (0° C.) was inoculated by streaking down the center longitudinally with several loops of culture. Other lots of steaks were inoculated by direct spraying using a one to 10 dilution of the well-shaken broth culture.

Steak pairs were removed from storage in a random manner, with the order of removal obtained by the use of the table of randomly assorted digits published by Snedecor *(15)*.

Surface bacterial counts were obtained on a slice 3 mm. in thickness, taken from the treated surface without removal of the wrapper. A Hobart Model 400 slicing machine was used. Repeated swab tests showed that the areas of the machine contacted by the meat were rendered sterile by thorough washing followed by a hot rinse with chlorine solution. This procedure was followed after each steak was sampled, and the machine was allowed to run to clear off residual chlorine solution before the next sampling.

[a] Data from a thesis submitted by O. D. Butler in partial fulfillment of the requirements for the degree of Doctor of Philosophy.

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Slices were handled with sterile forceps. The cellophane was removed and the slice was weighed on a torsion balance to one-hundredth gram. The balance pan was sanitized.

After weighing, the slice was transferred to a sterile Waring Blendor jar, which had been sterilized in the autoclave. Sterile distilled water was added to give a one to 5 dilution, and the meat was cut in the jar for one minute. By use of a sterile pipette, a sample was removed from the jar and used for further dilutions, or for plating, using tryptone-glucose extract agar medium. Plates were incubated at 50° F. (10° C.) for 4 days before counts were made.

The bacterial techniques employed were patterned after the recommendations of the Subcommittee on Microbiological Methods of Meat Research as reported by Sulzbacher *(17)*.

Storage conditions. Storage conditions were recorded by use of a Foxboro filled system recording thermometer with a Dynalog Dewcel for determination of the relative humidity. Air movement was measured with a Hastings Air Meter, and approximated 25 feet per minute in both cooler and self-service case.

A Hussman case was used to store the lots of steaks observed under self-service conditions. The temperature and relative humidity for each lot are reported in the results. The room housing the self-service case had a temperature of about 70° F. (21.1° C.) and a relative humidity of about 30%.

The temperature given for the different lots in the self-service case was measured at the storage rack level in the area where steaks were stored. Records obtained by use of a potentiometer showed that the temperature at the upper (treated) surface of the steaks averaged 3° F. (1.7° C.) higher than the rack level temperature.

Color measurement. Detailed instructions were given by Voegeli *(20)* on the application of disk colorimetry to color measurement of meats. The Munsell system was applied as described by Nickerson *(14)*. The hue, value, and chroma were combined into one number for statistical treatment by use of the Nickerson *(14)* formula for index of fading,

$$I = \frac{C}{5}(2\Delta H) + 6\Delta V + 3\Delta C.$$

The standard selected was hue 7.0, value 4.0, and chroma 8.0, which was approximately the color of some very bright steaks measured after treatment with oxygen under pressure.

Estimation of the percent metmyoglobin was essentially as applied by Mangel *(13)*, but using myoglobin extinction coefficients given by Bowen *(4)*. Samples of the same extracts used for bacterial counts were centrifuged 6 minutes at 5000 r.p.m., decanted, and filtered through Whatman No. 40 filter paper. Further dilution followed before measurement with the Beckman Model B spectrophotometer at wave lengths of 544 and 582 mμ. The total pigment concentration was obtained by conversion of the pigments to the CN derivative by adding a trace of potassium ferricyanide and of potassium cyanide to each container after initial readings were obtained, and measuring the optical density of the CN derivative at 540 mμ. Concentrations between 0.02 and 0.03 M. (expressed as myoglobin) worked well in the spectrophotometer, and most of the solutions measured fell within this range.

Extracted myoglobin is somewhat unstable, and the percent metmyoglobin increases with time after storage as shown by Mangel *(13)*. For this reason, results are somewhat empirical, and standard procedure is necessary. Immediate reading in the spectrophotometer after extraction would give best estimation of the percent metmyoglobin in the sample, but such procedure does not fit well into routine determinations for multiple samples. In this study, readings were made one hour after extraction.

The pH of the extracts was recorded. Packages were weighed into and out of storage to determine shrinkage. Estimates of the total pigment concentration in the samples, expressed as myoglobin, were calculated.

RESULTS

Inoculated and control pairs were stored at temperatures of 40° F. (4.4° C.) and 34° F. (1.1° C.) in the self-service case, and at 32° F. (0° C.) in the cooler. Sample numbers, respectively, were 57, 64, and 64. Bacterial counts were not made on the samples stored in the cooler. Counts were made on the remaining 121 samples, and color measurements were made on all samples.

The correlation coefficient between the index of fading and $\log_{10}$ bacterial count for the 121 samples was $+0.807^{**}$. The regression coefficient for $\log_{10}$ bacterial count vs. index of fading was 1.805, with a standard error of estimate of 4.07. The equation for estimation of index of fading from $\log_{10}$ bacterial count was $I = 8.25 + 1.805$ ($\log_{10}$ bacterial count).

Data obtained from the 64 samples stored at 34° F. (1.1° C.) are shown in Figures 1, 2, and 3 in graphical form. These samples showed more contrast in the response of the inoculated compared to the control steaks because of the greater success in obtaining control steaks with bacterial populations approaching zero. In all cases, regardless of the temperature of storage, however, the inoculated samples became discolored before the control samples.

Figure 1 shows the rates of discoloration of control and inoculated samples with storage.

Figure 2 shows the increase in bacterial population with time of storage. The numbers shown on the graph lines represent the average percent metmyoglobin obtained on 2 samples each day.

Figure 3 shows the response of the percent metmyoglobin to time of storage for inoculated and control samples.

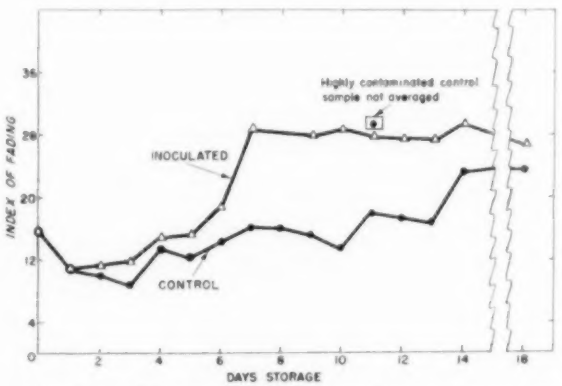

Figure 1. Effects of bacterial inoculation and storage on rates of discoloration of prepackaged beef steaks (average of two lots), with storage in a self-service case at 34° F. (1.1° C.), 55% relative humidity.

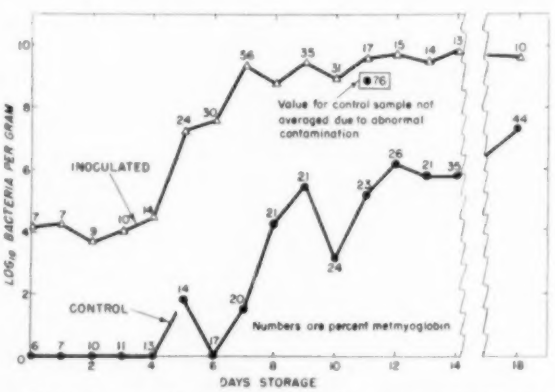

Figure 2. Growth curves of bacteria on prepackaged beef steaks (average of two lots) stored in a self-service case at 34° F. (1.1° C.), 55% relative humidity.

DISCUSSION

Bacterial growth reduced the salable shelf-life of beef steaks in all cases observed. Changes which were

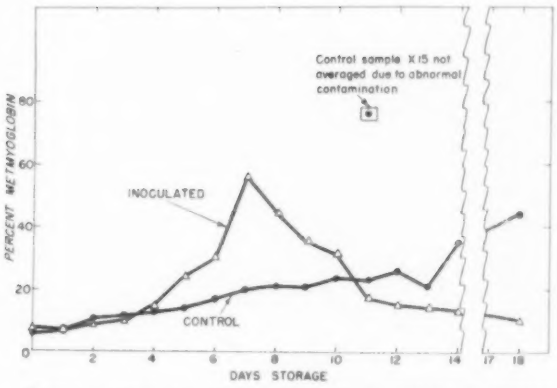

Figure 3. Response of metmyoglobin percentage on storage for inoculated and control prepackaged beef steaks (average of 2 lots) stored at 34° F. (1.1° C.), 55% relative humidity.

caused or speeded by bacterial growth included discoloration due to increased rate of metmyoglobin formation, production of off-odors, and slime formation. Usually the changes appeared in the order mentioned. Any one of these could render the meat unsalable.

With reference to Figure 1, if an arbitrary index of fading of 20.0 were chosen as the value at which packages became unsalable due to discoloration, the control samples had an increased shelf-life compared to the inoculated samples of 7 days. The control samples showed an advantage of 5 days at 32° F. (0° C.) in the cooler, and the inoculated samples reached the index of fading value of 20 only after 9 days' storage. In contrast, in the self-service case at 40° F. (4.4° C.), the inoculated samples reached the 20 value for index of fading after 3 days' storage, but the control samples had an advantage of 4 days' longer shelf-life.

Shelf-life was clearly prolonged by lower initial bacterial contamination, and by reducing the storage temperature.

Discoloration in fresh meats is caused by drying, and by oxidation of myoglobin to metmyoglobin, as shown by Brooks *(6)*. Drying was not a predominant factor in these tests, as the steaks were wrapped in cellophane (MSAT-80). The main cause of initial discoloration was formation of metmyoglobin.

Brooks *(7)*, and George and Stratmann *(8)* showed that the rate of metmyoglobin formation from myoglobin increased with decreasing oxygen pressure and increasing temperature of storage. The maximum rate occurred at oxygen pressures of about one to 4 mm. Hg. Though specific tests were not conducted here to find the pathway by which bacterial growth increased metmyoglobin, the evidence indicated that reduction of oxygen pressure was responsible. Allen *(2)* stated that duPont cellophane 300 MSAT-80, as used here, had low oxygen permeability. It is well known that the oxygen demand of aerobes in the logarithmic growth phase is very high. By reference to Figure 2, it is evident from the metmyoglobin percentages shown on the curve for the inoculated samples that the big increase in metmyoglobin occurred during the apparent logarithmic growth phase. This feature is not as clearly demonstrated on the curve for the controls, but that was due probably to the increased fluctuation in bacterial counts on the controls. Actually, the bacteria on the control samples had probably just entered the logarithmic growth phase in the last stages of the test, where sharply increased metmyoglobin percentages were shown.

Additional evidence to indicate the importance of oxygen relationships can be drawn from Figure 3. Brooks *(5)* demonstrated that some oxygen was essential for metmyoglobin formation. Hewitt *(9)* pointed out that it was common for bacterial cultures to develop reducing conditions by using the available oxygen, particularly during the logarithmic growth phase. The response of the inoculated samples as shown in Figure 3 followed predictions based on the principles of Brooks *(5)* and Hewitt *(9)*. When oxygen was reduced to critical pressures, the metmyoglobin percentage increased rapidly. Further reduction of oxygen pressure apparently resulted in reducing conditions, and the metmyoglobin percentage was sharply reduced by reduction to myoglobin. The color which resulted was very similar to the myoglobin color of freshly cut beef before brightening due to oxygenation had occurred. At this stage the samples could be brightened to approximately the original desirable color by exposure to oxygen under pressure. Two samples were exposed to an oxygen pressure of 30 pounds p.s.i., and a desirable color was attained, but rapid deterioration to metmyoglobin occurred, even though the samples were stored at 32° F. (0° C.) in the cooler. The very high bacterial populations probably caused the rapid change.

As shown on Figures 1, 2, and 3, the response of one control sample was decidedly different from the others. The atypical discoloration, high bacterial count, and very high metmyoglobin percentage all pointed to the probability that excessive contamination had occurred in preparation and packaging of the steak.

Growth of the flora on the refrigerated samples did not result in a significant amount of putrefaction, as shown by the absence of the typical odors of putrefying meats, and by only moderate increases in pH. These findings agreed with the observations of Kirsch *et al. (11)*. Moderate to heavy slime and off-odors, as observed by Kraft and Ayres *(12)*, did result after bacterial populations reached approximately the magnitude found to be critical by them of about 2 million per sq. cm.

Though estimates of the total pigment concentrations were somewhat crude, a definite increase of concentration with storage was obtained. This was expected due to some reduction in moisture content of the surface slices with storage. No "destruction" of the pigments by bacteria, as proposed by Allen *(1)*, was evident.

SUMMARY

The effect of bacteria on the color of prepackaged beef steaks stored under varying conditions was studied. Bacteria commonly found on meat cuts caused discoloration. The main effect, an increase in the rate of metmyoglobin formation, was greatest during the logarithmic growth phase.

Desirable color was maintained longer at 34° F. (1.1° C.) than at 40° F. (4.4° C.) in a self-service

case. A temperature of 32° F. (0° C.) was more effective than a rack level temperature of 34° F. (1.1° C.) in the self-service case.

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Effect of Application of Heat on Tomato Juice Color[a,b]

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(Manuscript received May 21, 1953)

The effect of heat application on the loss of color in tomato juice was found to proceed in accordance with the equation: Color loss $= \log \frac{Ts}{525}\left(\frac{RT-120}{40}\right)$ where color loss is in terms of the U. S. Department of Agriculture scoring system, Ts refers to temperature summations in terms of degrees F., above 140 times seconds, and RT is the retort temperature.

Color is the most important single factor involved in the quality evaluation of tomato products *(8)*. With the recent development of high temperature and tubular sterilization methods the processor has the opportunity of selecting from a wide array of heat sterilization procedures the one most satisfactory for his purpose. Since maximum color retention is extremely important, the processor should have at his disposal some means of predicting just how a given procedure will affect the color of the finished product.

This study was undertaken in an effort to find the basic law governing the extent of color loss resulting from the application of heat to tomato products.

It has been observed generally that the color of tomato juice deteriorates as a result of heat processing. These observations have been supported by experimental studies by MacGillivray *(6)*, and more recently by Robinson *et al. (7)*, Friedman *et al. (3)*, and others *(5, 10)*. Blumer *et al. (2)* reported that when equivalent sterilizing values were used, there were no color differences between samples of juice flash sterilized at temperatures varying from 250 to 270° F. However, some statements not substantiated by experimental data, were made to the effect that higher sterilization temperatures resulted in higher color losses, although there is a general impression that high temperature short time processes favor color retention for heat processed foods as a general rule.

MATERIALS AND METHODS

In order to obtain rapid heat transfer into the tomato juice sample, a heat exchange cell was fabricated (Figure 1) from $\frac{1}{16}$

[a] Presented at the Thirteenth Annual Meeting of the Institute of Food Technologists, Boston, Massachusetts, June 23, 1953.

[b] Scientific Publication No. A404, Contribution No. 2432 of the Maryland Agricultural Experiment Station (Department of Horticulture). A report of work done under contract with the United States Department of Agriculture, and authorized by the Research and Marketing Act of 1946. The contract is being supervised by the Eastern Regional Research Laboratory of the Bureau of Agricultural and Industrial Chemistry.

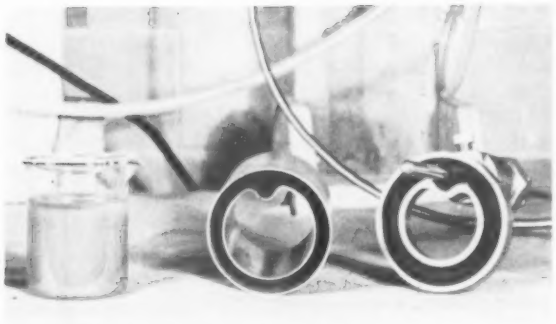

Figure 1a. Details of the heat exchange cell.

inch stainless steel tubing. A 6.2 cm. outside diameter tube was nested into a 8.2 cm. tube, so that with a small amount of milling the distance between the two tubings was 8 mm. The length of the tubing was 12 cm. Thus the volume of the cell which consisted of the space between the tubes could contain a sample of approximately 200 ml. none of which was more than 4 mm. from the surface. Temperatures were recorded with a Taylor recording instrument equipped with a transmitter to eliminate temperature lag. Results with this recorder were checked against a similar cell equipped with thermocouples, and temperatures determined with a potentiometer. The assembled cell containing the sample charge and the temperature measuring element was placed in an oil bath where the temperature could be controlled to ±.5° C. The temperature of the oil bath was set at 10° F. intervals beginning with 160 to 285° F., which was the maximum temperature at which the oil bath functioned accurately. The oil in the bath, and the heat exchange cell were kept under constant agitation in order to facilitate rapid and uniform heat transfer. In one series of experiments, the cell was held in the oil bath until the bath temperature was reached in the sample. In another series, the cell was held in the bath for different periods of time after maximum temperature was reached in the sample. Upon removal from the bath, the cell was immediately placed in one of three cooling tanks which consisted of (a) tap water, (b) ice water, and (c) acetone cooled with dry ice. Altogether 291 heating-cooling curves were obtained in this manner (Figure 2). The tomatoes used for this study were of the Rutgers variety, grown at the Plant Research farm of the University of Maryland. Sound tomatoes of good color were selected at all times; however, since the studies extended over the entire harvesting season, from August to October, 1952, it was impossible to obtain tomatoes of identical color throughout the season. The results were therefore reported in terms of color loss as compared to the original raw tomato

Figure 1b. Assembled heat exchange cell about to be inserted in the oil bath.

juice color rather than in terms of the actual color of the heated juice.

The tomatoes were cored and trimmed, and juiced in a miniature laboratory pulper and finisher, using a .028" screen. A sample was removed for immediate color analysis, and the remainder was used as charges in the heat exchange cell in order to obtain the heating-cooling curves described above.

Color was determined by the use of the Hunter color and color difference meter *(4)* which was first standardized with a tomato red color title. The "a" and "b" Hunter values were then trans-

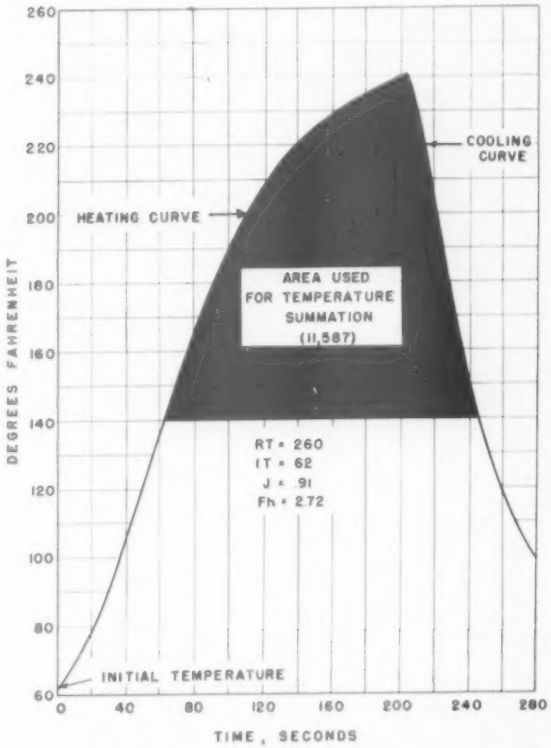

Figure 2. A heating-cooling curve, showing area used for obtaining the temperature summation. In this instance, juice with initial temperature of 62° F. (IT) was placed in heat exchange cell, and the cell immersed in the oil bath held at 260° F. (RT). The cell was removed from the oil bath when the temperature of the juice reached 240° F. (top of heating curve) and cooled in ice water (cooling curve). The actual temperature summation for this sample was 11,587 second-degrees.

formed to the equivalent U. S. score for canned tomato juice in accordance with the following equation:

$$\text{U. S. color score} = 32.6 + .682a - 1.678b$$

A nomograph for obtaining U. S. color scores in accordance with this equation, is presented as Figure 3. The color loss resulting from any given application of heat was then obtained by subtracting this U. S. score equivalent obtained for the heated sample from that obtained on the original unheated juice.

The area under the heating-cooling curve was obtained by the use of a planimeter, and reported in terms of seconds degrees Fahrenheit summations, above a given temperature base. Thus with a baseline set at 140° F., one second at 141° F. was equivalent to one temperature summation (second-degree) while one second at 240° F. was equivalent to 100 temperatu e summation, etc.

DISCUSSION OF RESULTS

In order to develop a single expression of the relation between the heat treatments and color loss, it was neces-

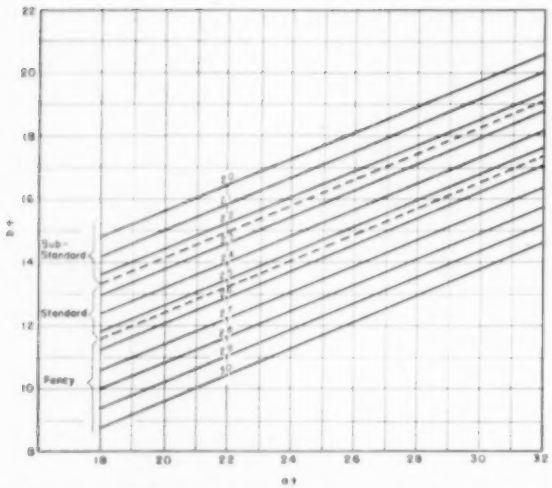

Figure 3. U. S. grades for tomato juice color in terms of Hunter a and b values.

sary to determine the nature of the correlation between these two factors, so that the regression line could then be used to predict the effect of any given heat application on color loss. Before such a correlation could be calculated it was necessary to have single values for each of these factors. Fortunately a method was available for converting Hunter color and color difference values into a single U. S. color grade equivalent value *(4)*. This was done, as described above.

For converting the heating-cooling curves to single values, the temperature summation method was employed. This method is in common use in evaluating the effect of temperature on plant growth *(9)*. Here the first problem is to establish the temperature "base line" —that is, the lowest point on the temperature scale which may have a measurable effect on the product. For plant growth, this point would be the lowest temperature below which there is little measurable growth, whereas in the present study, it would of course, be the lowest point below which there is no measurable color loss.

This point on the temperature scale may be determined by correlating the dependent factor, in this case color loss, with temperature summations as calculated from different base lines. The results shown in Table 1 indicate that the highest correlation was obtained using 140° F. as a base line.

TABLE 1

Correlations between color loss and temperature summations calculated at different base lines (bath temperatures 230-285° F.)

Base line, ° F.	Correlations	
	Linear	Logarithmic
120	.895	.927
140	.909	.942
160	.893	.921

It was therefore concluded that 140° F. is the highest temperature at which there is no appreciable loss in tomato juice color. The data in Table 1 also indicate that the relationship of color loss to temperature summations is logarithmic rather than linear. Although the best correlation of .942 is remarkably high, considering the fact that different batches of tomatoes were used, it was nevertheless apparent from examination of the data, that as the bath temperatures were increased, color loss was greater for the same temperature summation. This is illustrated for several bath temperatures in Figure 4. Correlations were therefore calculated for individual bath temperatures, with the following results:

TABLE 2

Correlations between color loss and temperature summations for individual bath temperatures

Bath temperature, ° F.	Correlation
230	.979
240	.965
250	.995
260	.979
270	.982
285	.970

Since all the individual correlations in Table 2 were significantly higher than the correlation of .942 for the combined data, separate regression lines were constructed for each temperature bath. Then with only slight adjustments for equal spacings, Figure 5 was constructed, showing the overall effect of heat application to color loss. This relationship may be expressed by the following equation:

$$\text{Color loss} = \text{Log}\,\frac{\text{Ts}}{525}\,\frac{(\text{RT} - 120)}{40}$$

Where color loss is expressed in terms of units of the U. S. grading system, Ts is temperature summations above 140° F., and RT is the retort temperature, being in this case, the temperature of the oil bath.

In order to use Figure 5 or the equation, it is necessary to know the temperature of the medium (retort,

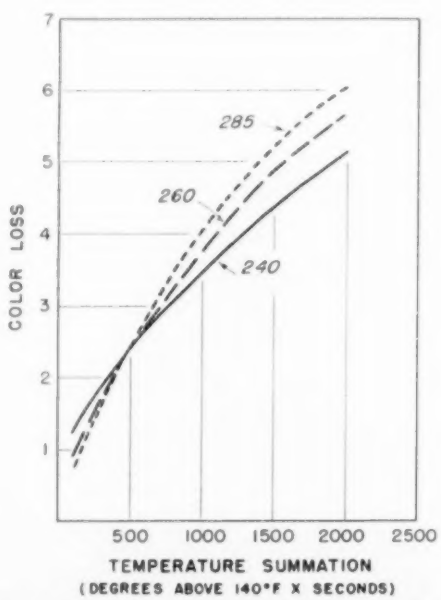

Figure 4. Regression curves showing the relation of temperature summations to color loss at specific bath temperatures.

tube, bath, etc.) and to have a complete heating-cooling curve (see Figure 2) from which the temperature summation may be calculated. This may be done rather laboriously by obtaining the sum of the seconds included under the curve for each degree above 140° F. Where extreme accuracy is not necessary, intervals greater than one degree or one second may be used. Heat summations may be obtained accurately and more rapidly by the use of a planimeter.

In order to utilize these curves to compare color loss that might be expected when different retort temperatures are used to obtain equivalent sterilization values, Ball's equations *(1)* were used on some of the heat penetration data obtained with the heat exchange cell. The results superimposed on Figure 5 show that there is little difference in the color of the tomato juice heated at different bath temperatures, although there is some tendency for the color loss to be greater as the temperature of the bath is increased. Similar results were obtained when temperature summations were estimated from the data of Blumer *et al. (2)*.

These results must be presented in terms of temperature summations rather than in terms of seconds or minutes at a given retort temperature because heat penetration in different containers varies; however, where internal temperature is equal to the retort temperature, color loss may be read directly from Figure 6, where minutes at the retort temperature are plotted against color loss.

The extremely high correlations of approximately .98 between color loss and temperature summations for any given retort temperature indicate that deterioration of tomato juice color during processing is a direct function of temperature. Rapidity of cooling apparently has no effect beyond its contribution to a reduction in the temperature summation. If some enzyme or enzymatic system were involved, it might be expected that a very

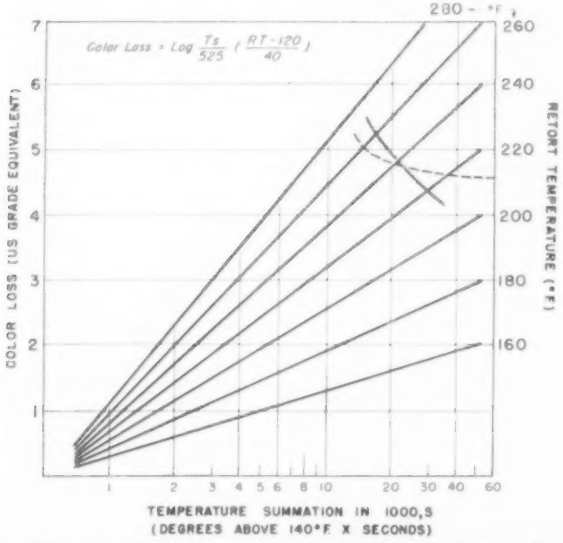

Figure 5. Relation of temperature summations to color loss at different bath temperatures. Broken line indicates predicted color loss resulting from heating at different retort temperatures for periods of time adequate for sterilization assuming an F_o of 0.7 for tomato juice.

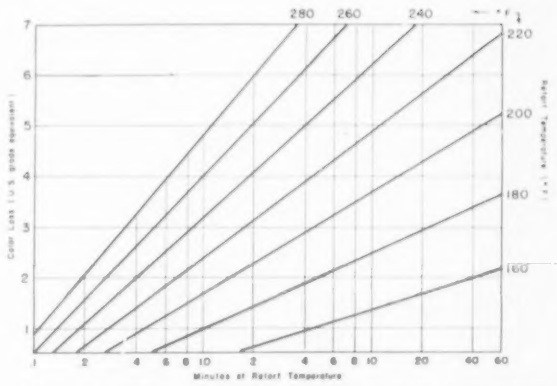

Figure 6. Effect of heating at different bath temperatures on color loss where juice temperature is the same as retort temperature.

rapid passage through some specific temperature zone would have an effect on color loss; however, no such evidence was found in the wide array of come-up and cooling curves obtained, and color loss in all cases proceeded along straight logarithmic lines.

No other factors were found to alter this conclusion that color loss is entirely a temperature function. In contrast to other reports *(6)* variations in atmosphere or pH had no effect on the rate of color loss. These results will be the subject of another paper.

Although these results provide a conclusive picture, several questions remain unanswered and should be the subject of additional work.

(a) Do heating media other than oil baths have a similar effect on color loss?

(b) What is the effect of two or more heating temperatures on color loss?

It is common practice to preheat tomato juice to from 160 to 205° F. before sterilization at higher temperatures. Since color loss is a logarithmic function, every increment in heating time results in a proportionally smaller increment of color loss. For example, tomato juice is preheated at 210° F. to 180° F., and cooled to 165° F. before processing at 260° F. The heat summation for the preheating curve is calculated at 5,000, and for the processing curve also at 5,000. Consulting Figure 5, we obtain a color loss of 2.2 for the preheating period. It is then logical to assume that the process heating at 260° F. would result only in a further color loss between 5,000 and 10,000 which on the 260° F. line would be 4.5–3.4, or 1.2 rather than a color loss of 3.4 which would be obtained if the 5,000 degree summations were taken from the 260° F. line between 0 and 5,000. The validity of such a procedure however, remains to be determined.

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Changes in Composition of Northwest Standard Delicious Apples During Storage That Affect Their Suitability for Juice Production

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(Manuscript received April 2, 1953)

Samples of Fancy-Extra Fancy and C grades of Standard Delicious apples were obtained from several packing houses in each of the three principal growing areas of Washington over a period from November, 1950 to June, 1951. Juices pressed from the various lots were assayed for total solids, total and reducing sugars, titratable acidity, pH, color, and suitability for juice manufacture by taste panel procedures.

A major problem of the apple industry of the State of Washington is profitable disposition of C grade Standard Delicious, which, in normal years, approximates 10 to 15% of this variety. In short-crop years, low-color apples move satisfactorily in fresh markets but, in other years, C grade tends to depress the price and slow the movement of higher grades. Separation of apples into the 3 recognized grades—Extra Fancy, Fancy, and C grade—is based almost entirely on percentage of surface which has developed satisfactory color. Substantial quantities of Standard Delicious are utilized as evaporated apples and, to a lesser extent, for canning. However, problems arising from shape and composition of this variety make it less desirable for these uses than so-called hard varieties.

Processors of apple juice and cider have found that Delicious apples are desirable for blending with other apples, since this variety has a pleasing aromatic quality which complements the flavor of juices of other varieties. Increasing tonnages of Delicious apples are being marketed as juice. Further interest has been stimulated by recent developments in the field of frozen concentrated fruit juices.

There have been numerous studies *(1, 4-13)* showing changes in composition of apples during the growing season on the tree and in storage. However, no comprehensive study has followed changes in composition of juice from apples during the course of the storage season. Moreover, only fragmentary data have been found on comparative composition of various grades of apples, and non on composition of juices obtained from the various grades. The Washington State Apple Commission and the Western Regional Research Laboratory accordingly collaborated on a project to obtain this information.

The survey was designed to provide information on (a) changes in C grade Standard Delicious apples that affect their suitability for juice and frozen concentrated juice; (b) range of composition of juices obtained from the C grade and Fancy-Extra Fancy Grade, selected throughout the season from various packing houses in the principal growing areas of Washington; and (c) differences in composition of juices obtained from C and Fancy-Extra Fancy grades.

Two types of samples were involved. For the first type, lots of orchard-run fruit were selected early in October in four packing houses in each of the three principal growing areas: Yakima, Wenatchee, and Okanogan-Oroville. These lots were graded and sufficient loose-packed boxes of C grade and Fancy-Extra Fancy grade for the survey were placed in cold storage. At monthly intervals, from October to June, representative samples (40-50 pounds) of C grade apples were drawn from the various lots. In some cases additional samples of Fancy-Extra Fancy grade were also selected and coded so that the two grades from the same lot of fruit could be identified. There were about twice as many C samples as Fancy-Extra Fancy. For convenience, fruit from these selected lots will be referred to as "regular" samples. There were from 15 to 20 "regular" samples per shipment.

The second type of samples, consisting of Fancy-

[a] Bureau of Agricultural and Industrial Chemistry, Agricultural Research Administration, U. S. Department of Agriculture. Report of a study made under the Research and Marketing Act of 1946.

Extra Fancy, as well as C grade, was selected at random each month from the lines of various packing houses in the three areas, without regard to origin or condition of fruit. With each sample of Fancy-Extra Fancy grade fruit, the corresponding C grade sample from the same lot was obtained and coded so that the paired samples could be identified. Additional C samples were included. There were from 4 to 13 "random" samples per shipment.

All samples were shipped to the Western Regional Research Laboratory by refrigerated truck and placed in refrigerated storage until used. Selection of "regular" and "random" samples was scheduled so that shipments were received alternately at intervals of approximately 2 weeks other than during November. All arrangements for selection and shipment were made by the Washington State Apple Commission.

For the comparison of Fancy-Extra Fancy with C grade, data for all Fancy-Extra Fancy and the corresponding C grade samples were used, including both "regular" and "random" samples. In comparing the composition of fruit from the 3 areas, data from only the "regular" samples of Fancy-Extra Fancy and C grade were used, since the random samples were largely obtained from the Yakima area.

Since the results reported in this paper have been obtained from only one season's work, the conclusions drawn should be considered as strictly applicable only to the 1950 season.

METHODS

On arrival at this Laboratory, all samples were held in refrigerated storage as long as one week until used. Before pressing, the general condition of the fruit was noted; this judgment was based primarily on number and extent of bruises. The apples were also examined for water core. Badly bruised and rotted apples were discarded.

After comminution in a stainless-steel hammer mill, the apples were pressed in a hydraulic press and the juice collected. No attempt was made to obtain yield data, since it was felt that results obtained from such small samples would not be valid. No additives were used to reduce or prevent enzymatic darkening.

About one-third of the juice from each sample was frozen in enameled No. 2 containers (307 x 409), stored at —10° F., and subsequently used in the analyses. The remainder was frozen in a single 30-pound enameled can and stored at —10° F. for subsequent preparation of full-flavored concentrate by the procedure developed at this Laboratory *(14)*. These concentrates were prepared from a blend of the latter samples of juice (after thawing and clarification) of a given grade from a single shipment. Thus each of the concentrates was a composite of the juice from 5 to 15 samples of a given grade, i.e., of all samples of this grade received in a single shipment. These concentrates, after reconstitution, were used in all the taste-panel studies. It was thought that by compositing samples of juice in this manner, individual differences within a given shipment could be balanced out and that a more accurate overall appraisal of suitability of the apples for juice production throughout the storage period could be obtained.

Total solids were determined by drying in a vacuum oven (24 hours at 60° C.). To save space, these results are not presented in chart form, as they agree closely with degrees Brix (soluble solids) determined by standard refractometric procedure. Sugars were determined by a modification of the Hassid ceric sulfate method *(2, 3)* and are expressed as dextrose, and acidity by titration with standard sodium hydroxide to pH 7.5 and calculation as malic acid. Color, expressed as percent transmission at 540 mμ, was determined with a photoelectric colorimeter on a sample of juice clarified by diatomaceous silica filter aid and a commercial pectin-degrading enzyme preparation. Pressure tests were made by a Magness tester with a 7/16-inch plunger. Measurements were made on the pared surface at 3 points around the circumference of each of 10 representative apples and the results averaged for each sample.

ANALYTICAL RESULTS

The general condition of the apples remained uniformly good throughout most of the storage season. By the end of March there was noticeable deterioration, manifested as much by internal browning as by surface bruises, rot, and other imperfections. C grade showed consistently more bruising than the Fancy-Extra Fancy. Water core was encountered less frequently as the season advanced and was more prevalent as a rule on Fancy-Extra Fancy than on C grade; apples from the Okanogan-Oroville area had a greater amount of water core than those from the other 2 areas.

Analytical data obtained from all C grade samples, including "random" as well as "regular," are shown in Figures 1 to 4. The average values of the individual analyses in a single shipment, segregated according to type of sample in the few instances where "regular" and "random" were included in the same shipment, are plotted. Two curves showing changes in composition of "regular" and "random" samples, as indicated by these average values, have been drawn. On several charts results obtained from individual samples are plotted, to show range of results. As would be expected, somewhat greater variation in composition was found in the "random" samples.

The Brix chart does not show a definite pattern of change during storage. There is no apparent reason for the rather sudden increase in degrees Brix during the first few weeks. It may be due partly to conversion of starch to sugar. After an apparent initial rise, total sugar tends to stay almost the same during the storage period (Figure 2). There is a striking increase in reducing sugar and in ratio of reducing to total sugar. This has been reported by other investigators *(6, 10, 13)*

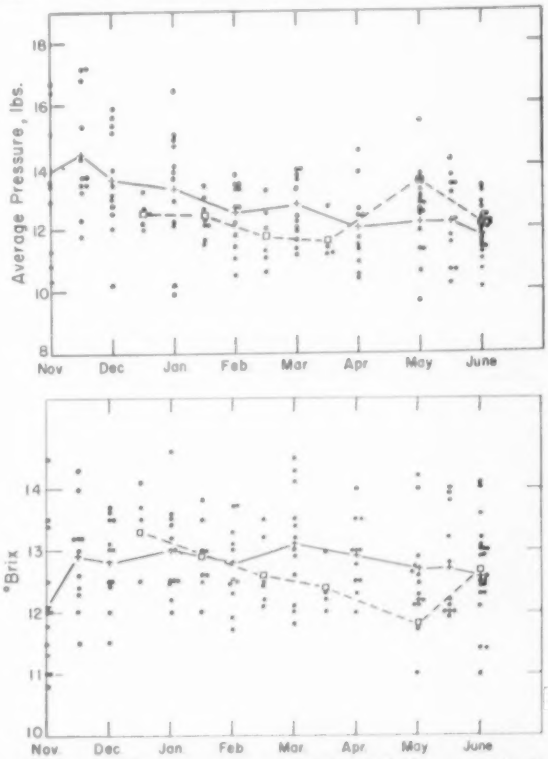

Figure 1. Effect of storage of Standard Delicious apples in commercial refrigerated warehouses on the firmness of the apples and on the composition of juice. + = C grade, "regular" samples; □ = C grade, "random" samples.

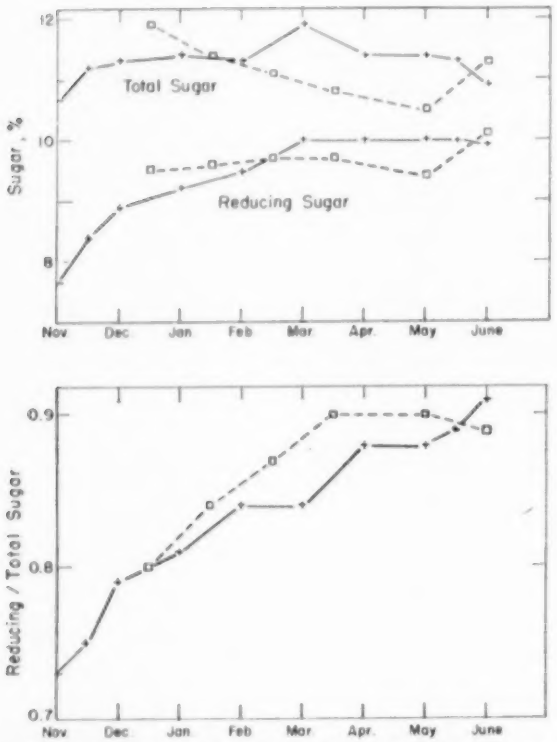

Figure 2. Effect of storage of Standard Delicious apples in commercial refrigerated warehouses on composition of juice. + = C grade, "regular" samples; □ = C grade, "random" samples.

and is due to conversion of starch and higher sugars in the fruit to reducing sugars. Total acidity decreases steadily throughout the storage period (Figure 3) with a corresponding increase in pH. The initial light amber color of the clarified juice became progressively deeper with increased storage time of the apples. This is shown in Figure 4 by the changes in transmission of light by the clarified juices. This darkening occurs to such an extent that it is quite apparent by casual inspection of a series of samples of clarified juice from apples stored for varying times. In general, the same changes with time were shown with Fancy-Extra Fancy as with C grade, but for the sake of simplicity these curves were not drawn. Changes in firmness are shown by the pressure tests in Figure 1. A gradual decrease in hardness of the apples was found as storage progressed.

Averages of results of various analyses throughout the storage season are shown in Table I. These results, on both "regular" and "random" samples, have been segregated so as to make possible comparisons of the composition of the juices according to grades and growing areas. Statistical analysis of data obtained from individual samples shows the following: When all samples of Fancy-Extra Fancy grade from the 3 growing areas and the corresponding C grade samples obtained from the same lot are considered, there are no statistical differences between the 2 grades in reducing sugar or color of expressed juice, and firmness of the apples as measured by the Magness pressure test. Total solids, Brix, pH, and total sugars are significantly higher ($P = 0.01$) and acidity is significantly lower ($P = 0.01$) in the Fancy-Extra Fancy than in the C grade juice. No significant differences in pressure tests for the 2 grades of apples were found when results from early, mid-

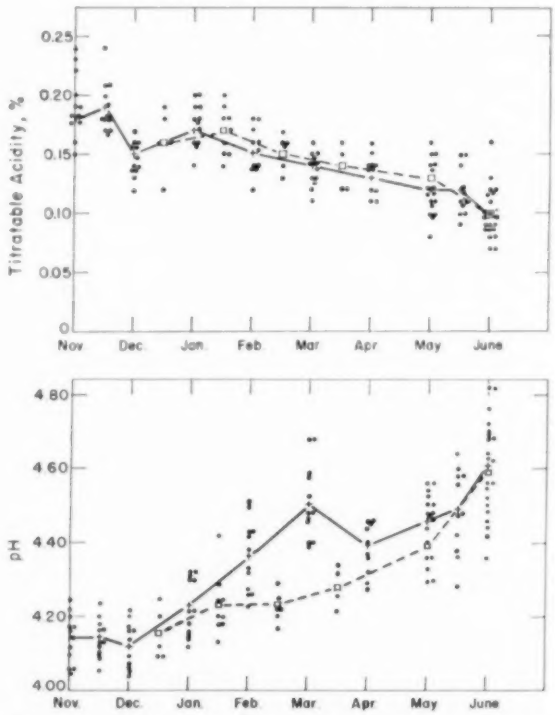

Figure 3. Effect of storage of Standard Delicious apples in commercial refrigerated warehouses on composition of juice. + = C grade, "regular" samples; □ = C grade, "random" samples.

TABLE 1

Summary of analytical data obtained from various samples of C and Fancy - Extra Fancy grades of Standard Delicious apples. Results are average values, except for figures in parentheses, which indicate range of values obtained

Grade	Growing area	Number of samples	Pressure[b] lbs.	Total solids %	Brix	Sugars		Total acidity %	pH	Color[c] (540 mμ)
						Reducing %	Total %			
Fancy-Extra Fancy	All	61	12.7 (10.0-19.0)	13.0 (10.5-14.3)	13.0 (10.0-14.2)	9.4 (6.8-10.6)	11.6 (9.3-12.8)	0.13 (0.07-0.18)	4.33 (4.09-4.72)	40 (18-66)
C, corresponding	All	61	12.8 (10.2-18.1)	12.7 (11.1-14.8)	12.8 (11.0-14.6)	9.3 (7.4-10.8)	11.3 (9.8-12.9)	0.15 (0.07-0.23)	4.30 (4.06-4.82)	38 (15-61)
Regular samples both grades	Yakima	57	13.8 (11.2-19.0)	12.6 (10.5-14.1)	12.6 (10.0-14.1)	9.4 (6.8-11.4)	11.3 (9.3-12.8)	0.15 (0.08-0.23)	4.30 (4.05-4.69)	34 (10-62)
Regular samples both grades	Wenatchee	58	12.6 (9.9-16.4)	12.5 (10.8-13.6)	12.6 (11.0-13.6)	9.3 (6.7-10.6)	11.1 (9.0-12.4)	0.14 (0.07-0.20)	4.35 (4.04-4.82)	44 (16-66)
Regular samples both grades	Okanogan Oroville	59	12.1 (9.7-14.6)	13.3 (11.1-14.8)	13.3 (11.0-14.6)	9.4 (7.4-10.8)	11.7 (9.8-12.9)	0.14 (0.08-0.24)	4.41 (4.12-4.72)	35 (15-63)

[b] Magness tester using 5/16" plunger.
[c] Percent transmission at 540 mμ with a 2-cm. cylindrical cell.

season, and late samples were segregated and analyzed separately. While it was found that juice obtained from C grade apples was significantly different statistically, it is doubtful that these differences have commercial significance.

Statistical analysis of the data obtained from "regular" samples from the three principal growing areas shows that these samples differ ($P = 0.01$) in several respects. Apples from the Yakima area gave the highest pressure tests and the juice was

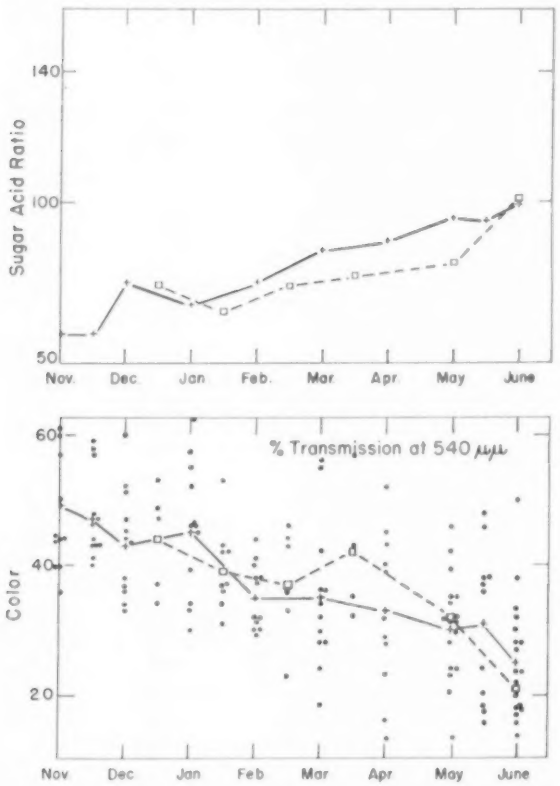

Figure 4. Effect of storage of Standard Delicious apples in commercial refrigerated warehouses on composition of juice. + = C grade "regular" samples; □ = C grade, "random" samples.

slightly more acid than in those from the other two areas. Juices from the Okanogan-Oroville area were higher in total solids and sugar, and those from the Wenatchee area lighter in color than were the samples from the other 2 areas. The magnitude of these differences observed between samples from the 3 principal growing areas is, in most instances, rather small and may have no commercial significance, since it is possible that the differences may result from the sampling technique employed or be due to unusual growing conditions in a given area. There was unusually heavy rainfall during the 1950 season, particularly during the harvest season.

TASTE PANEL RESULTS

In the taste-panel evaluation of these samples, the purpose was to find the point where substantial deterioration in flavor was first evident. All tests were conducted with concentrates prepared from a composite of the juices from individual samples of a given grade from a single shipment as described earlier. These concentrates were reconstituted to 12.5° Brix regardless of the original solids of the single-strength juice. The samples were compared under the light of a sodium lamp to avoid differentiation by color.

In one series of comparisons, concentrates prepared from the "regular" series of samples of C grade were used. In the comparison of 9 different concentrates available, prepared from juice expressed from apples at intervals from November to June, a balanced incomplete block system was used whereby in four sittings, with 11 trained panel members each time tasting 4 samples, each sample was tasted 6, 7, or 8 times against every other sample. In this comparison a rather marked change in character of the juice was noted early in April. A similar change was noted in a comparison of concentrates from the "random" samples, but it occurred at least one month earlier. At these times the juice acquired a "cider" or "storage" taste not considered pleasing by most of the panel members and definitely different from earlier samples.

A comparison of C grade with the corresponding Fancy-Extra Fancy grade by triangular-differentiation taste test showed little difference in suitability of the 2 grades for juice manufacture. There was some indication that early in the season, juice from Fancy-Extra Fancy grade was preferred while later in the season C grade was considered to be more acceptable (Table 2).

TABLE 2

Comparison of Fancy-Extra Fancy and C grades by triangular taste test

Date of receipt of sample	Number of judgments	Number correct	(P) Probability[a]	Preference[b] Fancy-Extra fancy	C
11-16-50	28	20	<0.01	14	5
12-13-50	30	21⅔	<0.01	11	9
1-9-51	30	13	>0.05	4	8
1-19-51	26	12½	>0.05	5	6
2-5-51	28	17	<0.01	13	4
3-7-51	24	8	>0.05	4	4
3-21-51	26	13	>0.05	5	4
4-4-51	24	14	0.05	2	12
4-27-51	30	14⅔	>0.05	7	6
5-7-51	24	15½	0.01	4	10
6-4-51	32	14	>0.05	5	6

[a] i.e., P = .01, a probability of 1 in 100, or P = .05, 5 in 100 that the numbers of correct judgments shown would have been obtained if there had been no difference between samples. Where P > 0.05, there is considered to be no significant difference between samples.

[b] Those not correctly identifying samples disregarded in this list.

SUMMARY

Samples of C grade and Fancy-Extra Fancy grade Standard Delicious apples were obtained from various packing houses in the 3 principal apple-growing areas of Washington over a period from October, 1950 to June, 1951. Juices were analyzed and their suitability for juice or concentrate was ascertained.

Reducing sugars and sugar-acid ratios increased markedly, titratable acidity decreased by roughly one-third, and the amber color of the juice grew progressively darker as storage proceeded. These changes occurred at approximately the same rate regardless of grade of fruit.

By taste panel procedures, it was found that juice from C grade apples is very similar to that from Fancy-Extra Fancy grade from the same lot of fruit throughout the storage season. Analytical data showed juice from Fancy-Extra Fancy grade fruit to be significantly higher in sugar and total solids and to have a slightly lower acid content than corresponding C grade apples. However, the magnitude of these differences is small.

Definite changes in flavor were noticed in March and early April in the various lots of fruit. A definite "cider" or storage flavor was found at this time, which changed the characteristic flavor of the juice markedly.

Acknowledgments

The authors are indebted to R. R. Legault for the planning of this work, to L. H. Walker and W. G. Dye for the preparation of concentrates, to C. C. Nimmo for taste panel evaluations and to Jean S. Wilbur for aid in the analytical work.

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Freezing Fish at Sea[a]

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(Manuscript received June 11, 1953)

The U. S. Fish and Wildlife Service's freezing-fish-at-sea program is reviewed. The review includes results of experiments on East and West Coast species of fish, freezing and thawing rates for fish frozen in sodium chloride brine and thawed in tap water, semi-commercial-scale processing of brine-frozen haddock, palatability tests, and a description of recent innovations on the experimental trawler Delaware. Some results of freezing-fish-at-sea experiments in British Columbia and Great Britain are discussed.

The U. S. Fish and Wildlife Service's Branch of Commercial Fisheries, for the past 5 years, has been investigating the feasibility of freezing fish immediately after catching for later defrosting, filleting, and refreezing of the fillets. These studies have been part of a refrigeration research program carried out at laboratories located at Boston, Massachusetts; College Park, Maryland; Ketchikan, Alaska; and Seattle, Washington.

In view of the wide variance in quality of fish brought into port and the loss resulting from the sale of less desirable fish, the development of successful methods of fish preservation, other than icing, aboard vessels would be extremely desirable. Freezing of fish immediately after catching offered the best prospect of providing a raw material for subsequent processing into frozen fishery products that would be of *uniform* quality throughout. This procedure would also provide a means of preserving freshness even during the extended fishing trips necessitated by the apparent scarcity of certain species of fish and the consequent greater effort and time required to bring in payloads.

The whole concept of freezing fish at sea, for later thawing, filleting, and refreezing of the fillets, runs counter to the popular belief that foods should never be frozen twice. Probably this principle was originated to discourage the refreezing of foods which had thawed during breakdowns of refrigeration or because of elevated temperatures during distribution. Under these conditions of haphazard thawing, the foods would be of questionable quality. Obviously, refreezing these thawed products would not improve their quality, and a slow refreezing in a home or retail store storage box would only aggravate the deterioration. However, it was believed that under *controlled* conditions, as for instance, with proper equipment on a vessel and in a shore plant freezing, thawing and refreezing should have little or no effect on the quality of fish.

This review of progress of investigations on freezing fish immediately after being caught, deals primarily with work carried out at the Service's laboratories. There is brief mention of the work performed along similar lines in other countries.

PRELIMINARY WORK

Stansby and Dassow *(15)* stated that the production of frozen packaged fish at sea has been handicapped by the additional expense of filleting and packaging aboard vessels. In addition, due to space limitations, fillet lines aboard vessels cannot attain all the refinements of those in shore installations. These investigators reasoned that the operation would be much simpler if the whole fish could be frozen, glazed, and held in a frozen condition aboard the vessel, and then after landing, be placed in cold storage for subsequent thawing, filleting, packaging, and refreezing at the convenience of the shore plants. It was felt that little or no harmful effect would result if thawing and refreezing were carried out under carefully controlled conditions.

To test this opinion, fillets from flathead "sole" *(Hippoglossoides elassodon)* and from yellowfin "sole" *(Limanda aspera)*

[a] Presented at the Thirteenth Annual Meeting of the Institute of Food Technologists, Boston, Massachusetts, June 23, 1953.

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were prepared, packaged, and frozen aboard the M. V. *Alaska* on the fishing grounds. At the same time whole, or "round," fish from each lot were frozen in a block and glazed for storage. Eleven weeks later the whole fish were thawed and filleted, and the fillets packaged and frozen at the laboratory in the same manner as were the fillets aboard ship. Organoleptic examinations of samples from both lots were made shortly after refreezing, and also after 5 and 10 weeks of additional storage at 0° F. A taste panel compared cooked fillets from both lots. On the basis of appearance and flavor, the refrozen fillets were equal or superior to the fillets packaged aboard ship. The texture of the refrozen fillets was satisfactory, with no increase in percentage of drip upon thawing.

Puncochar *(12)* pointed out that the need for improvements in handling and preserving procedures for fish on American fishing vessels that would result in the production of uniform quality frozen fishery products is receiving considerable attention from the fishing industry. He pointed out that production of quality fishery products by the smaller vessels of our fleet, which make trips of short duration, does not constitute a problem, since the fish are in prime condition when landed. On the large vessels, however, the "post mortem" age of the fish when brought into port varies considerably. For this reason, production of frozen fishery products of uniform high quality from fish caught by larger vessels, constitutes a problem and a challenge to the American fishing industry. It was further pointed out that if the concept of freezing fish at sea for later processing into refrozen fish fillets ashore could be substantiated by experimental data, a number of advantages would result. Among these advantages would be:

(a) Frozen fish production of uniform high quality,

(b) Larger payloads of fish, since vessels could stay longer on distant fishing grounds,

(c) Utilization of prime quality by-products, such as livers and viscera, which are not now brought ashore and utilized to any extent,

(d) Less work at sea for the fishermen, in that fish would not have to be gutted and iced,

(e) Increased efficiency of shore processing plants, since fish frozen aboard vessels could be held in commercial cold storage ashore for use as needed.

Later, Puncochar *(13)* reported on preliminary experiments made on species of bottom fish common to the banks in the North Atlantic that were undertaken aboard the research vessel *Albatross III*. These preliminary experiments indicated that fillets processed from fish frozen in the round at sea were equal to or in some cases better than fillets prepared from fish that were iced.

Pottinger, *et al. (10)* pointed out that since best results in frozen storage were obtained with products of high initial quality, the need for preparing fillets for freezing from fish in strictly fresh condition is apparent, and that prime quality fish for filleting could be obtained by freezing them immediately after capture (catching) and storing them in this condition until they were landed. From work carried out on the effect of refreezing on quality of sea trout *(Cynoscion regalis)* fillets, it was concluded that immediate freezing with subsequent thawing, filleting, and refreezing of the fillets causes no marked adverse effect on quality over frozen fillets prepared from freshly caught iced fish.

Hartshorne and Puncochar *(5)* compared fillets prepared from fish frozen in-the-round aboard a vessel at sea with fillets prepared from fish eviscerated at sea and held by the usual icing procedures. From data secured on percent drip, salt content, trimethylamine content, and keeping quality, the fillets from fish frozen at sea were found to be as good as, or better than, the fillets prepared from corresponding lots of iced fish. The percentage yield of fillets from round-frozen and thawed fish was somewhat higher than that for iced fish.

Although these results were highly encouraging, the experiments were considered to be on too small a scale to warrant their direct application to any proposed commercial operation. Therefore, the various possibilities and problems connected with freezing fish aboard a typical New England trawler and thawing them at shore processing plants were studied in considerable detail prior to freezing fish at sea aboard the Service's experimental trawler *Delaware*. Magnusson, Pottinger, and Hartshorne *(8)* found that the method of freezing fish by immersion in cold brine appeared to be well suited for commercial fishing vessels and therefore it was adopted for the initial tests. A review of the literature and preliminary experiments indicated that thawing in circulating water was the most practical method of thawing the frozen whole fish so that they could be filleted. Salt penetration into the fish flesh did not seem to be a serious problem.

EXPERIMENTS ON THE TRAWLER DELAWARE AND IN SHORE STATION

Butler, Puncochar and Knake *(2)* described the experimental trawler *Delaware* and shore facilities for the Service's freezing-fish-at-sea program. The vessel's freezing equipment was modified somewhat as a result of experiences in operation, and the present layout of the vessel and its equipment is shown in Figures 1, 2, and 3.

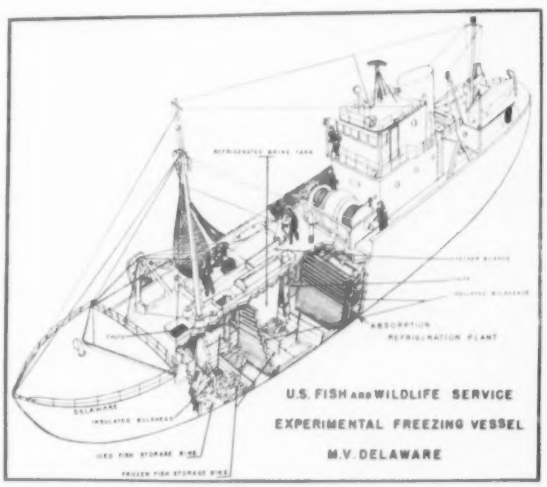

Figure 1. Cutaway view of the Delaware, showing location of the refrigeration system and storage bins.

Butler and Magnusson *(3)* presented preliminary data on operations resulting from the first semi-commercial processing of fish caught and frozen in-the-round on the *Delaware*. They observed, when the fish were processed in a typical filleting plant, that:

(a) Thawed round brine-frozen scrod haddock offered no complications in scaling and filleting aside from the usual period of minor adjustments in the technique used by the workers,

(b) The yield of fillets obtained from the round frozen fish was at least as high as that from control lots of iced, dressed fish,

(c) The appearance of the fillets from brine-frozen haddock was in all instances comparable with that of good quality fillets from iced fish,

(d) No new problems are posed in the filleting, packaging and freezing of fillets from brine-frozen, water-thawed fish,

(e) Filleting the whole fish rather than the dressed fish posed no problems during the filleting operation,

(f) The appearance, flavor, odor and texture of the fillets from round brine-frozen fish, thawed in fresh water, are quite acceptable.

Figure 2. Deck view showing location of freezer and manner in which fish are loaded into freezer.

Magnusson and Hartshorne *(9)* determined freezing rates in an experimental freezing unit in which the fish were placed in a rotating screen drum. It was found that the effect of the buoyancy of the brine on the fish made it difficult to secure adequate agitation of the fish by simply circulating the brine. The fish packed together into a mass, which if allowed to remain undisturbed, froze slowly, like a single, very large fish. The rates required to freeze completely (temperature throughout below 25° F.) whole cod and haddock of various thicknesses are shown in Table 1. In studies of the thawing operation, it was found that a simple water circulating system provided adequate agitation of the thawing fish. Thawing time for frozen whole round cod and haddock of various sizes in circulating water at 60° F. is shown in Table 2.

TABLE 1

Time required to freeze whole round cod and haddock of various thicknesses in circulating sodium-chloride brine at 10° F. and 0° F.

Thickness[a]	Approximate[b] Round Weight	Freezing Time	
		10° F.	0° F.
Inches	*Pounds*	*Minutes*	*Minutes*
1½	1 – 1½	55	35
2	1½ – 2½	85	55
2½	3 – 5	125	80
3	4½ – 7½	170	110
3½	7 – 10	220	145
4	9 – 12	280	185

[a] Side to side thickness (smallest diameter or vertical axis of a cross section) at the point of maximum girth.
[b] Round weight is generally 10 to 15% higher than dressed weight.

TABLE 2

Time required to thaw frozen (0° F.) whole round cod and haddock of various thicknesses in circulating water at 60° F.

Thickness[a]	Approximate[b] Round Weight	Thawing Time at 60° F.	
		Completely	For Filleting
Inches	*Pounds*	*Minutes*	*Minutes*
1½	1 – 1½	60	50
2	1½ – 2½	100	85
2½	3 – 5	150	125
3	4½ – 7½	210	170
3½	7 – 10	280	220
4	9 – 12	360	285

[a] Side to side thickness (smallest diameter or vertical axis of a cross section) at the point of maximum girth.
[b] Round weight is generally 10 to 15% higher than dressed weight.

Magnusson *(7)* indicated that the time required to thaw round, frozen fish depends primarily on the temperature of the defrosting medium, on how efficiently the medium circulates past each fish, and on the size and shape of the fish. Because a commercial operation normally involves a wide variety of sizes of fish, a batch-thawing process was considered the most practical. An outline drawing of a tank for water-thawing frozen fish is shown in Figure 4. Approximate operating cost attributable to the thawing process is estimated at 50 cents per 1000 pounds of fish thawed. This cost includes water, fuel and electric power, but does not include the cost of labor and the cost connected with the storage of frozen fish.

Pottinger, Holston and McCormack *(11)* found, as a result of palatability tests, that no definite preference was indicated for fillets prepared from unfrozen fish as compared to fillets from brine-frozen and thawed fish, the fillets in both cases being frozen immediately after processing. Percentages of drip have shown some variation between once-frozen and twice-frozen fish but in general these differences have been insignificant. Under optimum conditions of brine-freezing, salt penetration into the flesh of the fish has not been found to

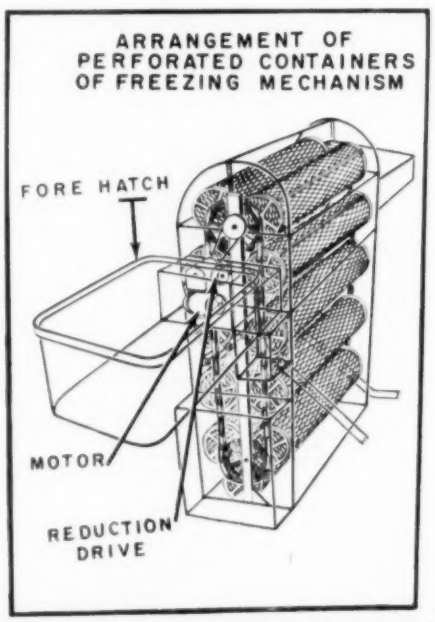

Figure 3. Interior arrangement of brine freezer showing perforated containers in which fish are placed for freezing.

be a problem. Even prior to water-thawing, the salt content of the flesh has not been objectionable, as shown by palatability tests on cooked samples; water-thawing reduces the salt content to approximately that of the flesh prior to freezing. Results have indicated that salt will continue to penetrate into the flesh if the fish, after being frozen, are allowed to remain in the brine.

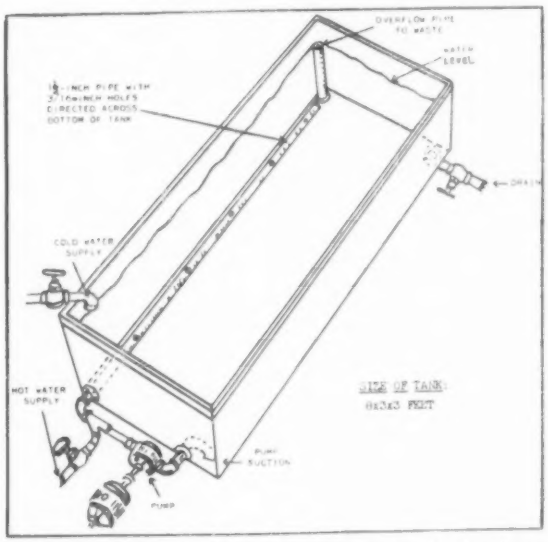

Figure 4. Outline drawing of tank for water thawing frozen fish in thousand-pound batches.

EXPERIMENTS IN GREAT BRITAIN AND BRITISH COLUMBIA

Banks *(1)*, in studies on the freezing and storage of fish, found that in order to maintain the quality of frozen fish, the best freezing and cold storage technique cannot improve the quality of fish, but can only fix the quality at the time of freezing. He states that cod and haddock should be frozen within 2 days after being caught and should be iced during that period to achieve the highest quality of the frozen product. He further states that larger quantities of fish can be brought back to Britain in satisfactory condition only by freezing the fish at sea in factory ships.

Later, Reay *(14)* found in trial runs with cod frozen in brine and then stored for some weeks at —10° F. without washing off the salt, that such fish could be thawed, filleted, refrozen, stored, and yield better fillets on final thawing than those obtained from 6 to 9 day-old unfrozen market cod.

Lantz *(6)* is carrying out experiments in British Columbia on the freezing of fish at sea. Fish are being air-blast frozen at sea aboard the *Tauranga*. In taste tests conducted with flatfishes such as brill and rock sole, 45% of the panel members preferred the samples frozen at sea, whereas 35% preferred the samples that had been iced at sea and frozen ashore. The remaining 20% did not express any preference. About 42% of the panel members expressed a consistent preference for halibut landed in ice 3 to 5 days after catching, frozen on shore, and stored at —15° F. About 31% preferred the halibut frozen at sea and held in frozen storage at —15° F. ashore. The remaining 27% of the group expressed no preference. Earlier tests indicated a marked preference for frozen as compared with iced halibut when the latter was held on ice at 32° F. for as long as 18 days.

Harrison and Roach *(4)* recently began an investigation on the application of brine freezing at sea as a means of improving quality of fish. Work done to date has been on a small scale in a eutectic solution of sodium chloride. These investigators found that the salt content of even the first layer under the skin of fish so frozen is well below the generally acceptable level for palatability (usually taken as 1%). They found that glazes on brine-frozen fish which had been washed after freezing appeared to be as good as those on air-frozen control samples. These workers speculate that if brine freezing proves practical, it could provide a very compact and efficient freezing system for small fishing craft.

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Composition and Quality of Commercially Cured Pork Shoulders[a,b]

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(Manuscript received June 3, 1953)

Cured pork shoulders produced by typical commercial methods were obtained from processing companies. These products were compared with respect to chemical composition, vitamin content, biological value of the protein, bacteriological flora and organoleptic characteristics.

Since most of the shoulders from hogs slaughtered in the United States are cured and smoked, it is important to know the effects of different methods of processing on the composition and nutritive value of the products. There is little literature dealing with investigations of this type of product. Therefore experiments herein reported were conducted to obtain information on this subject.

A survey made of the typical methods used in commercial curing of shoulders showed that there are four predominant methods. These are practically identical to those used in curing commercial hams. These methods have been described by us in a previous report *(5)* and are identified as: I, sweet pickle, quick-cured, tendered; II, sweet pickle, quick-cured, ready-to-eat; III, sweet pickle, long cured; and IV, the dry-cured Smithfield process. Where possible 3 samples of each type of cured picnic shoulders were obtained from a large, an intermediate, and small-sized packing company to represent Types I, II, and III indicated above. In the case of Type IV (Smithfield), the shoulders were full-cut instead of short-cut, and were obtained from 3 well-known processors of such products. There was a total of 9 samples representing each of Types I and II and 7 samples representing Type IV. Type III shoulders were difficult to obtain and consequently were represented by only 4 samples from a large and small-sized company.

Each sample was analyzed for chemical composition, palatability, growth-promoting value of the protein, the content of certain vitamins, and bacterial flora.

CHEMICAL COMPOSITION

The shoulders were analyzed for proximate composition, fat and protein breakdown, chloride content, and pH. The methods of analysis reported are the same as described in the previous paper *(5)*.

Table 1 shows average values and Figure 1 gives a graphic summarization of the various types of cure in relation to each other.

As observed, the 3 types of brine cured shoulders (Types I, II, and II) showed in general similar chemical composition, with the exception of Type III samples from Company A.

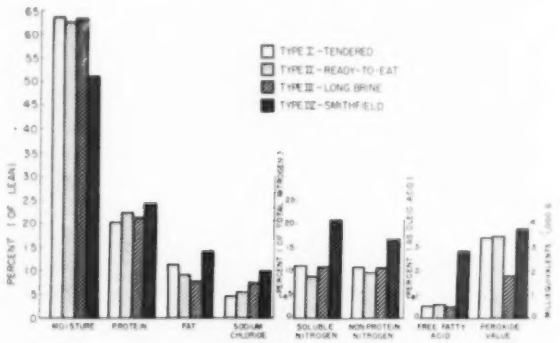

Figure 1. Comparative chemical composition of different types of shoulders. Values based on averages obtained in analyzing 4 to 9 shoulders of each type.

[a] Report of study made under the Research and Marketing Act of 1946.

[b] W. R. Kauffman determined the proximate composition of the samples; G. G. Snider conducted the tests for biological value of the protein; M. Berman performed the vitamin determinations; and H. S. Tubiash the bacteriological studies.

TABLE 1

Chemical composition of different types of commercially cured shoulders

Types of cure	No. of samples	Moisture	Protein (N × 6.25)	Fat	Ash	Sodium chloride	Soluble nitrogen	Non-protein nitrogen	Free fatty acids (as oleic acid)	Peroxide value, m.e.q. per 1000 g.	pH
		%	%	%	%	%	%	%	%		
I											
A,[c] large	3	63.8	20.8	10.3	5.28	4.82	10.2	11.2	0.65	1.08	6.60
B, intermediate	3	64.2	19.5	10.0	6.17	5.53	10.5	9.7	0.49	8.14	6.34
D, small	3	62.2	20.0	13.5	4.78	4.37	12.6	11.3	0.40	1.06	6.58
Average		63.4	20.1	11.3	5.41	4.91	11.1	10.7	0.51	3.43	6.51
II											
A, large	3	61.0	21.5	10.5	6.72	6.49	8.55	9.44	0.43	3.92	6.46
B, intermediate	3	62.5	21.5	9.3	5.93	5.75	8.42	8.85	0.89	4.86	6.09
E, small	3	63.7	22.9	7.9	5.06	4.80	9.22	10.54	0.45	1.69	6.32
Average		62.4	22.0	9.2	5.90	5.68	8.73	9.61	0.59	3.49	6.29
III											
A, large	1	58.0	20.4	8.62	12.73	11.56	13.4	12.2	1.23	1.79	6.21
E, small	3	64.8	21.4	7.61	6.41	6.26	9.9	10.2	0.26	1.79	6.34
Average		63.2	21.2	7.86	7.99	7.59	10.8	10.7	0.51	1.79	6.31
IV											
G, intermediate	1	52.1	23.7	15.3	10.8	10.4	22.8	17.2	3.45	5.64	6.15
H, intermediate	1	53.2	26.4	9.3	10.9	10.1	16.7	14.7	2.80	3.38	5.88
I, intermediate	3	49.0	23.7	16.6	10.4	9.6	19.5	16.6	2.26	1.98	5.96
Average		51.0	24.1	14.2	10.6	10.0	20.5	16.5	2.85	3.75	6.03

[c] Different processing companies from which samples were obtained are indicated by capital letters A, B, D, E, G, H, and I.

These were noticeably lower in moisture and correspondingly higher in salt. The dry-cured Smithfield shoulders (Type IV) had significantly less moisture, but were higher in the other chemical constituents. These differences were the result of considerable dehydration, enzymatic proteolysis, and fat hydrolysis and oxidation which occurred during the 7 to 12 months' storage at ambient temperatures at Smithfield, Virginia.

The average pH of the brine cured shoulders ranged from 6.31 to 6.51 and for the Type IV shoulders it was 6.03. This lower value of the Smithfield shoulders was probably due in part to the observed high free fatty acid content. It may be of academic interest to note that Callow *(2)* reported that the normal reserve of glycogen in a fully rested pig at death gave an ultimate pH of 5.4 to 5.6.

As a matter of interest, the following are some of the noticeable differences between commercially cured picnic shoulders and hams *(5)*. The moisture content of the brine cured shoulders (63%) was nearly 5% lower than that of the brine cured hams (67.8%). The mild cured shoulders (Types I and II) had, respectively, 4.9% and 5.7% salt in comparison with the same types of hams which contained 4.0% and 3.6% salt. Although there was only one sample of Type III obtained from a large packing company, the sodium chloride content appeared abnormally high. On the average the Type IV shoulders were likewise somewhat higher in salt content than the corresponding hams previously reported. Moreover, the Type IV (Smithfield) shoulders in comparison with the hams showed, respectively, 20.5% and 35.1% for soluble nitrogen; 16.5% and 26.9% for non-protein nitrogen; 2.85% and 9.28% for free fatty acids, and 6.03 and 5.92 for pH. These higher values of the Type IV hams were undoubtedly due to their longer storage period (12 to 17 months).

ORGANOLEPTIC ANALYSIS

The various types of commercially cured shoulders were prepared for taste testing in a manner similar to that previously described for commercially cured hams *(13)*. Uniform slices, ⅛ inch thick, were cut from the triceps muscle for judging the desirability and intensity of the flavor of the lean, as well as its color, tenderness, juiciness, and the degree of saltiness. Samples of the intermuscular fatty tissue were provided the judges for scoring the desirability and intensity of the fat flavor, and the color of the fat.

The meat samples were judged at room temperature, using score sheets similar to those used for commercial hams *(13)*. On the score sheet adjectives describing relative degrees of intensity and desirability were given numerical values from *one* to *five* indicating increasing intensity or desirability. Mean scores for each group of shoulders are presented in Table 2.

An analysis of the variance among the ratings given by the judges was made using Student's 't' test. The Smithfield-type shoulders had a more pronounced flavor of fat and lean than the other types, but the differences were not great enough to be significant at the 5% level when the comparisons were with the lean portions of the Tendered and Ready-to-Eat products. A briny, smoky flavor of both fat and lean tissue was characteristic of all the shoulders studied. In addition a cheesy flavor was noted in the Long Brine and Smithfield type shoulders, especially in those of the latter type. Since ratings for desirability of flavor are subjective, the opinion of as small and select a group as the judges involved in this test must be viewed with reservation. The mean scores for these factors are given in Table 2.

The shoulders produced by all 4 types of cure were "moderately salty" to "very salty." Although it would appear from inspection of the data on saltiness that the Smithfield shoulders were appreciably more salty than the other types tested, variation within the groups studied was so great that this difference did not prove to be significant. The greatest differences between products from the various types of cure were found in the juiciness of the lean meat. The Tendered shoulders were the juiciest, the Ready-to-Eat were next, and little or no difference was found between representatives of the Long Brine and Smithfield cures. The samples tested ranged from *slightly* to *moderately juicy* and were rated *moderately tender* to *tender*. Differences in tenderness between types were not great. The Tendered products were considered more tender than those representing the Long Brine and Smithfield methods of curing. The color of the lean from the various products ranged from a dark pink to a dark red. The Long Brine and Smithfield types were somewhat the darker in color. The fat from the Tendered and Ready-to-Eat shoulders was creamy white, from the Long Brine product a light yellow, and that from the Smithfield type product was a pronounced yellow in color.

Pork shoulder cuts, cured by the 4 most commonly used commercial methods (Tendered, Ready-to-Eat, Long Brine, and Smithfield type), were found to vary less in those qualities measured by organoleptic tests than did the similarly cured hams previously reported.

BIOLOGICAL VALUE OF THE PROTEIN

In the determination of the biological or growth-promoting value of the protein in shoulders, the diets for rats were made up essentially as previously described by Hoagland and coworkers *(7, 8)*. Since the sodium chloride content of different lots of the samples varied, the salt content of each diet in the series was adjusted at the same level. Sufficient ether-extracted, dehydrated lean tissue from these shoulders was used to supply 10% of protein. The average gain in weight of eight male albino rats in 30 days for each gram of nitrogen consumed was considered the "biological value."

The biological or growth-promoting values of the protein are shown in Table 3. Omitting the products from Company E, there was not a great deal of variation in the biological values of the protein among the shoulders studied. However, both in Type II and Type III the Company E shoulders were distinctly lower than any of the others. The history of these products is inadequate to determine the reason for this difference.

VITAMIN CONTENT

There is considerable variation in the literature with respect to the vitamin content of fresh and cured pork. McIntire and coworkers *(9)* reported that for fresh hams and loins, the thiamine content ranged from 7.4 to 15.2; for riboflavin from 1.6 to 3.0 and for nicotinic acid from 31 to 49 γ per g. Schweigert, McIntire, and Elvehjem *(11)* in a study of cured hams from four hog carcasses, reported that the thiamine, riboflavin, and nicotinic acid content varied from 33.9 to 51.4; 12.8 to 16.5; and 122 to 163 γ per g. of protein, with an average retention of 85%, 104%, and 106%, respectively. Vail and Westerman *(12)* showed a variation in thiamine content of 26.3 to 36 γ per g.

TABLE 2

Palatability scores of four types of commercially cured shoulders

Palatability factor tested	Type of product							
	Tendered		Ready-to-Eat		Long Brine		Smithfield	
	Mean	Range	Mean	Range	Mean	Range	Mean	Range
Fat tissue								
Flavor intensity	3.2	(2.3-3.6)	3.3	(2.7-3.7)	3.1	(2.6-3.6)	3.8	(3.3-4.5)
Flavor desirability	3.8	(3.2-4.1)	3.5	(3.1-3.9)	3.8	(3.4-4.1)	3.1	(2.6-3.6)
Lean tissue								
Flavor intensity	3.7	(3.4-3.9)	3.7	(2.8-3.9)	3.8	(3.5-4.0)	4.0	(3.4-4.0)
Flavor desirability	4.1	(3.4-4.2)	3.7	(3.3-3.9)	3.8	(3.6-4.2)	3.3	(2.5-3.6)
Saltiness	2.0	(1.8-2.0)	2.0	(1.3-2.6)	1.7	(1.4-2.0)	2.6	(1.8-3.0)
Juiciness	3.5	(3.1-4.2)	3.2	(2.6-3.7)	2.8	(2.7-3.0)	2.9	(2.7-3.1)
Tenderness	3.9	(3.3-4.3)	3.6	(2.9-4.5)	3.1	(2.3-3.7)	3.3	(2.9-4.0)

TABLE 3

Average growth-promoting values of protein in four types of commercially cured shoulders [a]

Description of sample	Gain and intake in 30 days				
	Gain in weight	Feed consumed	Nitrogen consumed	Feed per gram gain in weight	Gain per gram of nitrogen
	g.	*g.*	*g.*	*g.*	*g.*
I					
A	79	267	4.274	3.40	18.49
B	72	270	4.318	3.74	16.76
D	64	261	4.167	4.11	15.34
Average	72	266	4.253	3.75	16.86
II					
A	80	268	4.286	3.38	18.53
B	79	267	4.270	3.38	18.59
E	49	226	3.620	4.63	13.58
Average	69	254	4.059	3.80	16.90
III					
A	79	275	4.404	3.52	17.88
E	46	223	3.572	4.91	12.85
Average	62	249	3.988	4.21	15.37
IV					
G	89	317	5.076	3.57	17.58
H	84	305	4.886	3.65	16.79
I	75	275	4.404	3.67	17.14
Average	83	299	4.789	3.63	17.17

[a] Average gain in weight of 8 male rats in 30 days.

for picnics from *2* different carcasses. Moreover, they found a wide variation among cuts from the same picnic from one carcass, ranging from 18.5 to 32.4 γ per g. on a moisture-free basis. In the case of cuts from a picnic from another carcass the range was from 23.1 to 44.1. The differences in riboflavin content were of a lesser extent. Dann and Handler *(3)* have shown that fresh pork muscle contains 41 to 102 γ per g. of nicotinic acid.

For vitamin analyses, a sample representative of the entire lean portion of each shoulder studied was prepared. Both thiamine and riboflavin values were obtained fluorometrically, and niacin microbiologically by methods essentially as described by the Association of Vitamin Chemists *(1)*. Any modifications required in these methods are previously described *(4)*. The results are reported on a protein basis.

Results shown in Table 4 are not strictly comparable since the original vitamin values before processing are not known. The average thiamine and riboflavin content ranged from 14.4

TABLE 4

Vitamin content of four types of commercially cured shoulders [a]

Vitamin	Type I		Type II		Type III		Type IV	
Thiamine	A	15.6	A	18.7	A	12.8	G	36.9
	B	22.1	B	16.1	E	16.0	H	29.8
	D	30.4	E	23.0			I	31.9
	Average	22.7	Average	19.3	Average	14.4	Average	32.9
Riboflavin	A	13.7	A	9.6	A	5.7	G	7.4
	B	12.0	B	8.9	E	7.6	H	19.4
	D	10.9	E	8.2			I	19.0
	Average	12.2	Average	8.9	Average	6.6	Average	15.3
Niacin	A	191.5	A	166.4	A	174.9	G	180.6
	B	136.0	B	160.5	E	149.3	H	187.5
	D	172.1	E	115.9			I	203.0
	Average	166.5	Average	147.6	Average	162.1	Average	190.4

[a] Values in micrograms per gram protein.

to 29.5 and 6.6 to 15.3 γ per g. of protein respectively, with Type III shoulders showing the lowest and Type IV the highest values. The average niacin value for the Type IV shoulders was also appreciably higher than that of the other types. Pence and coworkers *(10)* and Heinemann *et al. (6)* have found that the dietary intakes of thiamine and riboflavin have a direct bearing on the content of these vitamins in the muscle tissue. It would therefore seem that the higher vitamin values of the Smithfield shoulders (Type IV) might be due in part to the peanut diet *(14)* of the hogs from which they were obtained.

Despite all the variations reported with respect to vitamin content, cured shoulders are an excellent source of thiamine, riboflavin, and niacin in the human diet.

BACTERIAL CONTENT

Intramuscular portions of each of the commercial shoulders were removed for bacteriological studies. Bacterial populations were determined from plates using veal infusion agar with the addition of 5% sodium chloride. Previous experience has shown that this medium is adequate for most of the common cured meat flora. Results are reported as number of organisms per gram of meat.

The results showed that of the *29* samples examined, *25* had no count. Practically all of the samples of Type I showed no count. Type II showed 7 out of 9 samples to have no count, the remaining *2* samples having 30 organisms each. Of the 4 Type III samples, 3 were found with no count and the other had an estimated count of over 7,000,000 organisms. This large number of organisms found in the latter sample was probably due to contamination occurring either before or after curing. In the case of the Smithfield shoulders, 6 had practically no count and 1 had approximately 1,000 organisms. None of the organisms found in any of the samples were anaerobic.

It should be borne in mind that the bacterial counts give only the number of viable bacteria, and, in the instances reported here, do not give any indication of the total number of bacteria which existed at one time or another in the shoulders.

SUMMARY

Commercially cured shoulders are produced by 4 typical methods: I, sweet pickle, quick-cured, tendered; II, sweet pickle, quick-cured, ready-to-eat; III, sweet pickle, long cured; and IV, the dry-cured (Smithfield process).

In general, the brine cured shoulders (Types I, II, III) showed similar chemical composition whereas the Type IV Smithfield shoulders were much lower in moisture and showed greater fat and protein hydrolysis.

The organoleptic tests showed that all products tested had a briny, smoky flavor in both the fat and lean tissues. A cheesy flavor was noted in the Long Brine and Smithfield types of shoulders, such flavor being more predominant in the latter. Tendered (Type I) shoulders were juiciest, the Ready-to-Eat (Type II) were next, and Long cured (Type III) and Smithfield (Type IV) shoulders were the least juicy. There were no significant differences in tenderness. All had an over-all rating of *good*.

With the exception of products from one company, there was very little variation in the biological value of the protein among the shoulders studied.

The thiamine, riboflavin, and niacin content found in the products studied, showed them to be very good sources of these vitamins.

In bacteriological studies samples were found to be sterile or nearly so.

Acknowledgment

The authors wish to acknowledge the assistance of Dr. H. R. Kraybill, Director, Department of Scientific Research, American Meat Institute Foundation, and Mr. C. B. Heinemann, President of the National Independent Meat Packers Association for their suggestions regarding typical commercial brine curing methods for shoulders; and the assistance of several producers of Smithfield products located in Smithfield, Virginia, in describing methods of producing Smithfield Shoulders.

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Reconstitution of Moisture in Popcorn by Steam Blanching[a]

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(Manuscript received May 17, 1953)

It is shown that steam blanching is a rapid method of rehydrating overdried popcorn and thereby increasing the popping expansion. Optimum length of blanch depends upon the initial moisture content. Blanching improves color of popcorn.

It has been demonstrated by Huelsen and Thompson *(2)* that popcorn may be artificially dried at temperatures ranging from 100 to 130° F. (37.8 to 54.4° C.) and reconstituted with water to the optimum popping range without detrimental effects. It proved to be impossible to control the drying operations so that the final moisture content coincided with the maximum popping volume. Further work on the project indicated that before artificial drying can be recommended for commercial use some method of reconstitution is needed other than adding water or storing in artificially humidified air as described by Dexter *(1)*. Blanching with steam suggested itself, but nothing is known concerning the rate of moisture uptake by popcorn and the effect of the accompanying high temperatures on popping expansion.

MATERIALS AND METHODS

Four hybrids representing as many different types of popcorn were selected for these experiments. These consisted of Iopop 5, Iopop 6, Purdue *32* and Illinois 52. Iopop 5 is a white double cross (11 x 15) x (5 x 12); Iopop 6 is a yellow three-way cross (Purdue Supergold inbreds 18 x 30A) x Ia. 28; Purdue *32* is also a three-way cross (Purdue Supergold inbreds 30A x 18) x South American 24 [Smith and Brunson, *(3)*], and Illinois 52 is a Japanese Hulless single cross.

Each of the 4 hybrids was planted at 3 different dates (May 14, June 5 and June 11, 1952) in order to give a wide range of maturities. Iopop 5 was harvested at 14.4 to 15.5%; Iopop 6 at 15.5 to 17.6%; Purdue *32* at 21.2 to 29.6% and Illinois 52 at 21% moisture. There was no evidence that immaturity at harvest had any adverse effect on popping expansion. Illinois 52 was used sparingly in the experiments due to the large percentages of diseased kernels which popped poorly or not at all.

The ears were dried at 110° F. (43.3° C.) in the thermostatically controlled bin drier described by Huelsen and Thompson *(2)*. The length of the drying period varied depending upon the initial moisture content. The final moisture content ranged from 7 to 13%. In some of the experiments discussed later the corn was shelled and dried further at 110° F. (43.3° C.) before reconstitution.

The popcorn was blanched at 208° F. (97.8° C.) in a specially constructed live steam blancher 10 ft. long equipped with a stainless steel mesh belt 12 in. wide. The steam was injected both above and below the belt. The 4 speeds could be varied with cone pulleys. Stop watch readings indicated that the respective blanching times were 52, 98, 173 and 357 seconds. The popcorn was spread 0.5 in. deep and 8 in. wide on the belt.

As specified later some lots of corn were canned. No. 1 picnic plain cans were used (211 x 400), the fill being 8 oz. per can. They were closed on a No. 1 Pacific semi-automatic vacuum closing machine under a 15-inch vacuum.

All moisture determinations were made in duplicate on 100 g. shelled samples placed in open 307 x 306 cans and are expressed on the wet basis. The drying equipment consisted of a large forced draft Despatch oven operated at a controlled temperature of 176° F. (80° C.) run with the vents wide open. The drying time was 144 hours at which time the samples reached constant weight.

In order to test the accuracy of this method of moisture determination a series of large samples was taken at random and each divided into 2 parts. One set was dried in the Despatch oven as described above, and the other was ground in a Wiley mill and then dried in a vacuum oven for 16 hours at 158° F. (70° C.) followed by storage in a desiccator for 5 hours before weighing. The moistures obtained by the 2 methods differed but slightly. The averages for all of the samples were 11.15% moisture for the open oven test and 11.36% for the vacuum oven test.

All samples were popped in duplicate in an official volume

[a] The assistance and advice of Prof. A. I. Nelson, Dept. of Food Technology, University of Illinois is gratefully acknowledged.

[b] Manufactured by C. Cretors and Co., Chicago.

tester.[b] The tester is equipped with a pyrometer and is standard except for an extended cylinder registering up to 40 volumes. The measure furnished for the popping compound was not used and a glass graduate substituted for the sake of accuracy. The volume measure for the popcorn was used, but variations up to 8 g. were noted in the amount of corn it contained. Accordingly each sample was measured 5 times and weighed. The 5 weighings were averaged and the sample actually popped was weighed. The corn was dumped into the popper when the temperature of the compound reached 470° F. (243.3° C.).

The subsequent discussion deals entirely with artificially dried popcorn blanched and popped in a series of 9 experiments. In most of the experiments the shelled corn was dried further at 110° F. (43.3° C.) in order to provide material with a low initial moisture content. Tests showed that blanching destroyed the germination of all samples, whereas those which were not blanched tested 95-100% viability. There was no evidence of any relation between germinability and popping expansion which is in accord with the longevity experiments of Stewart (4), who popped corn at successive periods until the kernels reached zero germination, but found no decrease in expansion.

EXPERIMENTAL RESULTS

Rate of moisture absorption. Iopop 5, 6 and Purdue 32 were dried to constant weight at 176° F. (80° C.). Duplicate 500 g. samples of each of the 3 varieties were blanched for 4 different periods (Table 1). One set of samples was spread on screen trays for 1 hour in order to permit the free moisture to be absorbed and evaporated. At the end of 1 hour when

TABLE 1

Length of blanch in relation to free and absorbed moisture in three popcorn hybrids dried to constant weight at 176° F. (80° C.) [a]

Leuth of blanch	Total moisture absorbed	Moisture absorbed during blanch	Free moisture
Seconds	%	%	%
52	4.45	2.98	1.47
98	4.61	3.48	1.13
173	5.10	4.17	.93
357	6.08	5.37	.71

[a] Duplicate samples.

the corn appeared dry to the touch each lot was sampled for a moisture test. The second set of samples was sealed in Mason jars as soon as blanched and permitted to absorb and equalize the free moisture for 10 days at 80° F. (26.7° C.) before moisture samples were taken. The total moisture absorbed was obtained from the samples held for 10 days. Subtracting from this the moisture content of the samples held one hour on trays gives the free moisture which was evaporated during the holding period (Table 1). The results show that the percentage of free moisture on the corn decreases rapidly in relation to the length of the blanch.

The experiment was repeated in much greater detail with the same 3 varieties, each with a different initial moisture content (Table 2). One set of samples was dried on trays for 2 hours at room temperature before moisture samples were taken. The moisture absorbed expressed in mg. per second per 100 g. of corn was greatest the first 52 seconds, followed by a greatly reduced rate for the longer blanching periods. It should be

TABLE 2

Rate of moisture absorption and free moisture on surface of kernels in relation to length of blanch in three popcorn hybrids

Time intervals	Iopop 5, initial moisture 8.69%		Iopop 6, initial moisture 9.89%		Purdue 32, initial moisture 11.19%	
	Absorbed	Free	Absorbed	Free	Absorbed	Free
	Rate of moisture increase during blanch as Mg./sec./100 g.					
First 52 seconds	33.88	28.85	25.19	36.54	29.04	39.42
Next 46 seconds	4.35	—6.52	4.35	—9.78	5.43	—5.43
Next 75 seconds	8.66	—1.33	7.33	—.66	7.33	—5.33
Next 184 seconds	.27	2.91	2.12	—.81	1.35	—.27

noted that for some reason the absorption decreased for all varieties during the second period followed by a higher rate during the third period which in turn was followed by another decrease. Apparently during the third period some of the condensed water on the kernels is absorbed at a more rapid rate. With one exception the free or condensed water decreases rapidly as the blanching period increases.

Table 3 contains a highly condensed summary of the average moisture absorption by 4 hybrids blanched 4 different periods and having a low compared with an optimum initial moisture content. Absorption was significantly greater only during the 357 second period. A somewhat similar comparison between the averages of the 52 and 357 second blanching periods is made in Table 7 where the latter absorbs significantly more moisture. It is obvious, however, that initial moisture content in the range of 7.27-11.45% (Table 3) has practically no direct effect on the total amount of moisture absorbed, although the final moisture content increases in relation to the initial moisture. The results in Table 4 are similar. In Table 5 where 3 hybrids with different

TABLE 3

Initial moisture content of popcorn in relation to absorption of moisture during blanching, averages of four hybrids, each replicated 4 times

Length of blanch	Average moisture			Popping expansion after blanching
	Initial	Absorbed	Total	
Seconds	%	%	%	*Volumes*
52	7.27[d]	3.36	10.63	28.2
98	7.27[d]	3.52	10.79	28.0
173	7.27[d]	3.73	11.00	28.3
357	7.27[d]	4.48	11.75	28.4
Least sig diff. 5%		0.27		0.91
Least sig diff. 1%		0.35		1.22
52	11.45[e]	3.28	14.73	30.3
98	11.45[e]	3.45	14.90	30.8
173	11.45[e]	3.46	14.91	30.3
357	11.45[e]	4.09	15.54	29.7
Least sig diff. 5%		0.42		0.85
Least sig diff. 1%		0.56		1.14

[d] Individual initial moistures: Iopop 5 = 6.95%, Iopop 6 = 7.10%, Ill. 52 = 7.15% and Purdue 32 = 7.90%.

[e] Individual moistures after blanching: Iopop 5 = 11.20%, Iopop 6 = 11.25%, Ill. 52 = 11.30% and Purdue 32 = 12.05%.

TABLE 4

Initial moisture content of popcorn in relation to moisture absorbed during a 52-second blanch and its effect on popping expansion [f]

Variety	Moisture			Popping Expansion		
	Initial	After Blanching	Increase	Initial	After Blanching	Increase
	%	%	%	*Vols.*	*Vols.*	*Vols.*
I6	7.10	10.55	3.45	22.20	30.25	8.05
I6	8.35	12.50	4.15	25.65	35.40	9.75
I6	9.89	13.10	3.21	30.00	35.75	5.75
I6	11.25	14.40	3.15	33.00	33.37	.37
P32	7.90	11.00	3.10	21.70	30.25	8.55
P32	9.15	13.14	3.99	28.87	34.85	5.98
P32	12.05	15.55	3.50	32.70	29.00	—3.70

[f] Averages of duplicate samples.

initial moisture levels were blanched for 4 periods absorption was higher in all cases during the 173 and 357 second periods.

There is some indication of a difference in varietal response to moisture absorption in Table 5, Purdue 32 having a higher rate than Iopop 5 or 6. A more comprehensive comparison in Table 6 indicates that when the initial moisture was low only Iopop 5 and 6 absorbed significantly more than Ill. 52 and Purdue 32, but when initial moistures were close to the optimum only Purdue 32 absorbed significantly more moisture than Ill. 52. From the results there is no evidence that there exists any consistent varietal difference in the rate of absorption.

TABLE 5

Length of blanch in relation to moisture absorption and popping volume in three varieties[a]

Variety	Length of blanch	Moisture			Popping Expansion		
		Initial	After Blanching	Absorbed	Initial	After Blanching	Increase
	seconds	%	%	%	*Vols.*	*Vols.*	*Vols.*
Iopop 5	52	8.69	11.90	3.21	22.0	28.50	6.50
	98	8.69	11.80	3.11	22.0	28.00	6.00
	173	8.69	12.35	3.66	22.0	27.75	5.75
	357	8.69	12.95	4.26	22.0	28.00	6.00
Iopop 6	52	9.89	13.10	3.21	30.0	35.75	5.75
	98	9.89	12.85	2.96	30.0	34.50	4.50
	173	9.89	13.35	3.46	30.0	35.25	5.25
	357	9.89	13.60	3.71	30.0	34.75	4.75
Purdue 32	52	11.19	14.75	3.56	32.0	32.75	.75
	98	11.19	14.75	3.56	32.0	32.50	.50
	173	11.19	14.90	3.71	32.0	32.50	.50
	357	11.19	15.10	3.91	32.0	31.75	—.25

[a] Averages of duplicate samples.

Blanching in relation to popping volume. The generally accepted optimum moisture content for maximum popping is 13%. Huelsen and Thompson *(2)* showed that for Illinois 52 the optimum is about 12%. Additional drying experiments with the 4 hybrids used in these experiments indicate that the optimum moisture content is slightly over 12% whether room dried, artificially dried at 110° F. (43.3° C.) or dried outdoors. There was, however, a considerable variation in the popping expansion even at the optimum moisture content which cannot be attributed to the method of drying. The maximum volumes of popping expansion obtained with Iopop 5 were 31.75; with Iopop 6, 38.25; with Purdue 32, 38.00; and with Ill. 52, 34.25. None of these samples was blanched. Iopop 5 proved to be the least responsive of the 4 hybrids and an expansion of 30 volumes was difficult to attain by any method. Iopop 6 and Purdue 32 were very responsive to reconstitution either by water added according to the method of Huelsen and Thompson *(2)*, or by blanching. Illinois 52 was intermediate in its response.

Iopop 6 and Purdue 32, the varieties most responsive to reconstitution, were blanched for 52 seconds, the initial moistures varying from low to about optimum (Table 4). Blanching increased the popping expansion of Iopop 6 for the initial moisture range of 7.10% to 11.25%. Expansion was satisfactory

TABLE 6

Varietal reaction to moisture absorption and popping expansion due to blanching, averages of four replications

Variety	Moisture			Popping Expansion		
	Initial	Absorbed	Total	Initial	After Blanching	Increase
	%	%	%	*Vols.*	*Vols.*	*Vols.*
Iopop 5	6.95	4.21	11.16	19.7	25.8	6.1
Iopop 6	7.10	3.94	11.04	22.2	30.3	8.1
Ill. 52	7.15	3.48	10.63	21.5	26.8	5.3
Purdue 32	7.90	3.47	11.37	21.7	30.0	8.3
Least sig. diff. 5%		0.27			0.91	
Least sig. diff. 1%		0.35			1.22	
Iopop 5	11.20	3.60	14.80	28.2	29.7	1.5
Iopop 6	11.25	3.66	14.91	33.0	33.1	0.1
Ill. 52	11.30	3.31	14.61	29.2	29.1	—0.1
Purdue 32	12.05	3.75	15.80	32.7	29.2	—3.5
Least sig. diff. 5%		0.42			0.85	
Least sig. diff. 1%		0.56			1.14	

even when the final moisture after blanching reached 14.4%. With Purdue 32 blanching increased popping expansion substantially except where the initial moisture of 12.05% was about optimum.

A further comparison of varietal response to blanching is made in Table 6 where the initial moistures are low and optimum. With low initial moistures Iopop 6 and Purdue 32 are significantly more responsive with respect to popping expansion than Iopop 5 or Ill. 52. Where the initial moisture was optimum blanching failed to change the popping expansion materially except with Purdue 32 which had a final moisture content of 15.8%. In Table 7 Iopop 6 and Purdue 32 responded much more favorably to blanching than Iopop 5 which barely exceeded the 30-volume expansion after a 357 second blanch.

The length of blanch averaged for all 4 hybrids (Table 3) had no significant effect on popping volume. A further comparison by individual varieties (Table 5) shows that the 52 second blanch gives the largest increase in popping volume. Comparison of the 52 and 357 second blanching periods (Table 7) for the same 3 varieties as in Table 5 shows that the average increases in popping expansion due to blanching fail to differ significantly.

TABLE 7

Moisture content in relation to popping expansion in three varieties of popcorn which were blanched and then canned, averages of 8 replications

Variety	Length of blanch					
	None		52 seconds		357 seconds	
	Popping expansion	Moisture	Popping expansion	Moisture	Popping expansion	Moisture
	Vols.	%	*Vols.*	%	*Vols.*	%
Iopop 5	22.25	8.60	29.57	12.49	30.65	13.53
Iopop 6	25.65	8.35	35.40	12.50	35.65	12.76
Purdue 32	28.87	9.15	34.85	13.14	35.15	13.46
Averages	25.63	8.70	33.27	12.71	33.82	13.25
Increases due to blanching			7.64**	4.01**	8.19**	4.55**

Least Sig. Diff. Moisture Averages, 5% = .24, 1% = .32
Least Sig. Diff. popping averages, 5% = .81, 1% = 1.10.

A summary of all the blanching experiments in Table 8 shows that the average popping expansion of 3 varieties artificially dried to the optimum moisture range differs very little from the average popping expansion of blanched corn. The optimum moisture range of blanched corn is 12-14% compared with 11-13% for unblanched corn.

Canning blanched popcorn. Popcorn which was blanched for 52 seconds and had considerable free moisture adhering to the kernels was immediately dumped into 30 lb. slip cover cans and stored at 80° F. (26.6° C.). Within two weeks the corn molded and was unfit for human consumption. Spoilage could be prevented by spreading the corn and allowing it to dry for 1 to 2 hours before placing it in the cans.

Since large quantities of popcorn are canned or marketed in sealed bags it was essential to determine whether blanched corn is likely to spoil. Three varieties of popcorn were blanched for 52 and 357 seconds and immediately packed in 30 lb. slip cover cans. The free moisture was absorbed in 24 hours and the corn was then packed in No. 1 picnic plain cans (211 x 400). Half of each of the 2 blanched lots was scanned without a vacuum and with a 15-inch vacuum, respectively. Each lot was again equally divided, half receiving no process and the other half processed for 45 minutes at 250° F. (121.1° C.). Six cans from each treatment were stored in an incubator at 98° F. (36.7° C.) for 64 days. In addition single cans of each treatment were stored at 35° F. (1.7° C.) for 52 days and then held at room temperature for an additional 64 days. The storage experiment had a twofold purpose, the first being to determine the amount of spoilage under different storage conditions and the second to determine the effect on the containers.

Since no data are available on heat penetration during processing popcorn this information was obtained by actually processing on a retort especially equipped with thermocouples for making such readings at the center of the can. Heat penetration was faster in the cans having a vacuum of 22 inches, but considerable paneling occurred. With a vacuum a temperature of 212° F. (100° C.) was reached in 31 minutes (Figure 1) but without a vacuum 37 minutes were required. Since complete sterilization is not necessary in a dry product a process of 45 minutes at 250° F. (121.1° C.) was considered sufficient.

All of the canned samples were popped as shown in Table 7. As blanching was the only treatment affecting popping expansion, the actual volumes are not reported separately in Table 9.

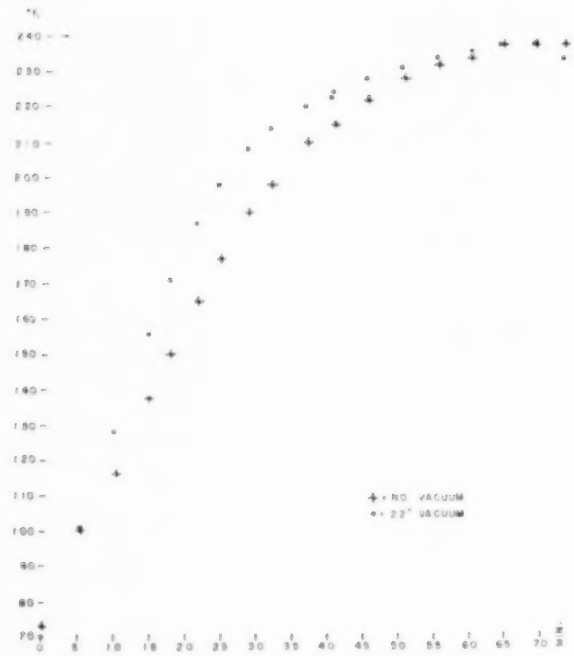

Figure 1. Heat penetration of popcorn in 211 x 400 tin cans with and without a 22-inch vacuum, processed at 250° F. (121.1° C.).

Iopop 5, normally amber colored, turned a tan color due to processing, irrespective of blanching. When blanched without processing the corn bleached to an attractive white. Unblanched Iopop 6 and Purdue *32* turned a dull orange color when processed without blanching. When blanched Iopop 6 and Purdue *32* bleached to a bright yellow and when processed they developed a scorched dull color. No odors of any kind developed in the unblanched canned samples, but processing had a variable effect on the odor of those which were blanched. Iopop 5 developed an odor only in the corn blanched *52* seconds, vacuum packed and processed. Iopop 6 and Purdue *32* each developed odors in all but one treatment. None of the odors were objectionable. They may be described as slightly scorched. Blanching bleached all the varieties to a bright attractive shade, but processing scorched the corn and produced a dull color. In addition diseased kernels turned very dark giving the corn an uneven appearance. There was no evidence of spoilage due to micro-organisms in any of the canned samples.

Some manufacturers claim that reconstituted popcorn tends to lose its expansion during storage. The group of samples held at 35° F. (1.7° C.) for 52 days and an additional 64 days at room temperature was compared with the group held at 98° F. (36.7° C.) for 64 days. There were no differences in vacuum, odor or can rust. However, there was a slight but consistent decrease in popping volume; as the magnitude of the decrease was the same in the samples receiving no other treatment except canning, it was concluded that blanching and processing are not the cause.

Rust developed in the crevices where the can body meets the lids and also along the side seam, but only in the cans processed after blanching (Table 9). The moisture level of the corn is not the factor causing rust. Because of its effect on the color of the corn and rusting of the can, processing is not recommended.

TABLE 8

Comparison of optimum moisture range of artificially dried popcorn not blanched and over-dried popcorn reconstituted by blanching

Variety	Unblanched				Blanched			
	No. of observations	Optimum moisture range	Popping expansion		No. of observations	Optimum moisture range	Popping expansion	
			Maximum	Average			Maximum	Average
		%	*Vols.*	*Vols.*		%	*Vols.*	*Vols.*
I5	7	11-13	30.5	28.71	16	12-14	31.0	29.22
I6	30	11-13	38.0	35.18	25	12-14	36.5	35.04
P32	32	11-13	36.0	33.45	21	12-14	36.5	34.43

TABLE 9

Characteristics of popcorn and No. 1 plain cans, respectively, with and without blanching, vacuum sealing and processing; stored at 98° F. (36.7° C.) for 64 days

Variety	Processed	Not blanched [b]			Blanched 52 seconds					Blanched 357 seconds				
		Vacuum	Moisture	Color	Vacuum	Moisture	Color	Odor	Rust	Vacuum	Moisture	Color	Odor	Rust
		In.	%		*In.*	%				*In.*	%			
Iopop 5	Yes	0	8.65	Tan	2.5	12.35	Tan	None	Slight	3.0	13.15	Tan	None	None
Iopop 5	Yes	14.5	8.50	Tan	16.0	12.55	Tan	Slight	Slight	16.0	13.35	Tan	None	Slight
Iopop 5	No	0	8.65	Amber	2.0	12.75	White	None	None	2.0	14.30	White	None	None
Iopop 5	No	15.0	8.60	Amber	15.5	12.30	White	None	None	16.0	13.30	White	None	None
Iopop 6	Yes	0	8.25	Dull Orange	2.0	12.50	Dull Yellow	None	Slight	2.5	12.70	Dull Yellow	Slight	Slight
Iopop 6	Yes	15.0	8.15	Dull Orange	16.0	12.30	Dull Yellow	Slight	Slight	15.5	12.70	Dull Yellow	Slight	Slight
Iopop 6	No	0	8.60	Orange	2.0	12.80	Bright Yellow	None	None	3.0	12.90	Bright Yellow	None	None
Iopop 6	No	15.0	8.40	Orange	15.5	12.40	Bright Yellow	None	None	16.0	12.75	Bright Yellow	None	None
Purdue *32*	Yes	0	9.10	Dull Orange	1.5	12.85	Dull Yellow	Slight	Slight	1.0	13.25	Dull Yellow	None	Slight
Purdue *32*	Yes	14.0	9.05	Dull Orange	15.5	13.25	Dull Yellow	Slight	Slight	15.5	13.65	Dull Yellow	Slight	Slight
Purdue *32*	No	0	9.15	Orange	1.0	13.00	Bright Yellow	None	None	1.0	13.05	Bright Yellow	None	None
Purdue *32*	No	14.5	9.30	Orange	14.0	13.45	Bright Yellow	None	None	15.0	13.90	Bright Yellow	None	None

[b] No odors or can rust developed in unblanched series.

SUMMARY AND CONCLUSIONS

Four varieties of popcorn were dried by artificial heat to low moisture levels and were reconstituted by means of a steam blanch of 52, 98, 173 and 357 seconds. The maximum rate of moisture absorption coincided with the shortest blanch followed by a decreasing rate for the longer periods. The corn blanched 52 seconds also had the largest amount of free moisture adhering to the kernels. The quantity of moisture directly absorbed by the corn increases with the length of the blanch. The final moisture content after blanching also varies in relation to the initial moisture in the corn. Varieties do not differ consistently in their absorption rate during blanching.

Steam blanching is a rapid method of rehydrating and thereby increasing the popping expansion in overdried popcorn. However, the amount of moisture absorbed and the subsequent popping expansion will depend upon the type of blanching equipment used and the depth of the corn on the blancher belt. In addition, varieties differ in their response. Iopop 5 was the least responsive, Ill. 52 intermediate while Iopop 6 and Purdue 32 were very responsive. Blanching increased popping expansion within a relatively wide range of initial moistures, from about 7% to slightly over 11%. In general the most favorable length of blanch depended upon the initial moisture content of the popcorn.

Canned blanched corn showed no evidence of spoilage, nor was the popping expansion adversely affected even after 64 days of storage in an incubator at 98° F. (36.7° C.). A second series stored at 35° F. (1.7° C.) for 52 days, followed by 64 days storage at room temperature also failed to show spoilage, but there were slight consistent decreases in popping expansion. Since all samples were equally affected these decreases could not be attributed to blanching and processing.

Blanching improved the color of popcorn. The white Iopop 5 was bleached to an attractive white, while the yellow Iopop 6 and Purdue 32 turned a lighter and brighter shade. Processing is not recommended as the color of the popcorn is darkened and can rust develops. No evidence of spoilage due to micro-organisms occurred in any of the lots.

Blanching destroyed the germination of all samples. Since the blanched corn popped satisfactorily viability of the kernels is not associated with popping ability.

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Notes and Letters

A Plea for Standardization of Organoleptic Test Methods

Perhaps the most important measure of the validity of any scientific experiment is its reproducibility. The oftener we are able to reproduce the same result from a given set of experimental conditions, the more confidence we can have in predicting the outcome of similar trials in the future. Only to the degree that we know and control the variables that govern a particular phenomenon, however, is it possible to reproduce observations. Certainly in no field is precise reproducibility and the exact control of variables more important than in analytical procedures, and it is primarily as an analytical tool that the recently developed techniques of organoleptic testing of foods are used. Since though, by definition, these methods are dependent on the response of human organs and organisms, we have an analytical method based on the most complicated possible system of variables.

Obviously if we are to improve the techniques now available to us it is absolutely essential to learn a great deal more about the variable factors involved. It will require many years and the contributions from many different scientific fields before we can hope really to understand even the most important of these factors. Meanwhile we must continue to use the tools available to us in the best manner possible to try to answer the practical problems with which food researchers and the food industries are constantly confronted.

It seems to a number of us in food acceptance work that the adoption of more or less uniform techniques for routine taste-testing would be of considerable benefit at this time, even though we do not yet know what techniques are best and would doubtless want to modify our methods from time to time as research makes further improvements possible. Standardization would help us to control many of the variable factors a little better. Furthermore, by having a standard method we could actually determine the reproducibility and validity of the methods presently in use. Also, when using a standard method, if wide variations still were found in the results of different laboratories, we would know that yet other variables are of importance and need to be considered and controlled, and we would know approximately where to look for them. One of the greatest benefits of standardization from a practical point of view is that the general use of a specified method would permit direct comparisons to be made between the results obtained by different laboratories. One of the principal activities of our laboratory during

the past two years has been the flavor evaluation of fruits and vegetables treated with various of the newer organic pesticides to determine whether any of these materials should not be used because of an undesirable effect on flavor. At least 10 other laboratories throughout the country are working on the same problem. Yet, though most of us use fairly similar techniques, none are identical enough to permit us to pool or compare our data except in a very general way. When one considers the large number of such pesticides that need to be tested, and the vast number of different crops they are used on, to say nothing of the variables of dosage, soil, climate, length of storage period, etc. about which data are desired, it is obvious how necessary it is to be able to evaluate each other's results in terms of our own findings if we are to avoid an impossible amount of duplication.

Even more important is the possible answer that standardization can make to what is perhaps the knottiest problem facing taste-panel work today. That is the correlation of the findings of small, selected panels with the response of consumers as a whole. It is not sufficient to tell an insecticide manufacturer or a canner that a carefully-trained, critical panel under specially selected experimental conditions was able to identify the treated sample with a highly significant probability. He wants to know what this means in terms of the response of consumers. Unfortunately, only by making extremely expensive, time-consuming consumer surveys does it seem possible at this point to predict consumer response with any accuracy. No one knows the relationship between panel response and consumer response. Indeed there can be no uniform relationship unless the methods of testing are themselves uniform. But large-scale consumer tests are impractical to use in most situations for reasons of size of sample required, time, and the enormous number of different treatments to be tested, as well as expense. If standard procedures are adopted, however, there is hope for a solution to the problem. Provided the methods used are truly reproducible it should be possible to arrange materials tested in decreasing order of their acceptability as judged by small-panel tests. In a few instances, the same products may be tested on large-scale consumer panels. The approximate degree of significance in difference or preference necessary in the small-panel judgments to result in a significant rejection by consumers can thus be determined, and perhaps used as a criterion for the acceptance or rejection of a given treatment. This would certainly end a vast amount of confusion among those who produce and sell pesticides, and those (mainly in the U. S. Department of Agriculture) who must register them for use.

Finally, standardization would facilitate research and communication of information among those of us engaged in the organoleptic evaluation of foods. It would be easier to run routine analyses, and results could be reported and interpreted more simply and precisely. This could mean more time to concentrate on the really fundamental problems in taste-testing and the development of new and better techniques to be incorporated into both routine and non-routine methods. Also a clear and detailed presentation of a standard, acceptable procedure would be a fine guide to investigators who are new in the field, or who use organoleptic procedures infrequently.

It may be of interest to mention briefly what is being done about the question of standardization. In February, 1952, at the National Canners Convention in Chicago, a group of 8 food technologists involved in the testing of pesticide-treated fruit and vegetable crops, plus a number of other people interested in these problems, met to discuss the techniques used and the difficulties experienced in our work. We decided that the first step should be to determine how nearly our individual evaluations of a given treated food agree with one another when each of us uses the particular experimental design that he now customarily employs. We have, since then, each prepared a detailed description of our experimental procedure. These were duplicated and distributed by the National Canners Association to those involved. We have available moderately large quantities of canned sweet potatoes which were grown in soil treated with various pesticides, along with corresponding control samples. Two of these treated samples have been selected, and sent, along with controls, to each of the investigators to be tested according to his own method. The results of these tests will be compared. After this we hope to select a few methods, preferably rather different from each other, to be followed as precisely as possible by each of the participating laboratories, again using the same treated sample and control for the whole group. Finally, if the results of the above experiments warrant it, we will try to get together and compromise on a basic procedure (or procedures) for organoleptic analysis that we feel represents the best practical method we can devise, with the knowledge now available to us, for use in routine work. Such a method would also have to be checked for its reproducibility in several different laboratories, of course.

It should be stressed, perhaps, in making this plea for standardization, that these recommended procedures would be intended for use on routine problems primarily, and should certainly not stifle further exploratory work on methodology. Even for routine work it would be up to the individual investigator to decide whether or not to use the standard procedure, though the maximum benefits of standardization are realizable only if the chosen method finds fairly general acceptance and use. Finally, any method outlined now should be regarded as tentative and mutable. As research in the fields of physiology, statistics, and psychology suggest better techniques for organoleptic testing, any standard procedures adopted now should be modified to incorporate them.

Elly Hinreiner
Department of Food Technology
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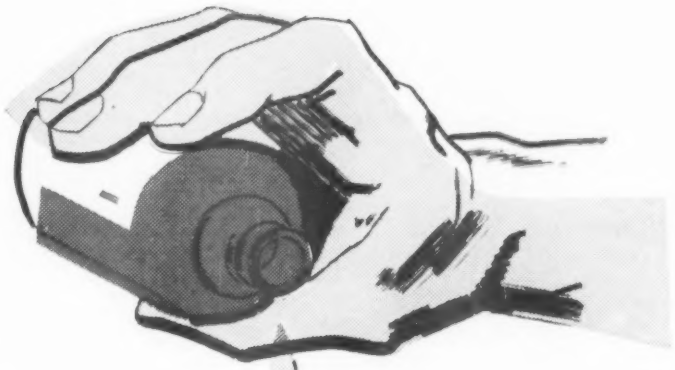
June 13, 1953.



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FOOD INDUSTRY TOPICS

(Continued from page 25 preceding technical papers)

A brand-new process of direct solvent extraction for oilseeds, called Filtration-Extraction, has been developed through the pilot-plant stage at the Southern Regional Research Laboratory of the Bureau of Agricultural and Industrial Chemistry, USDA. The process will shortly go into commercial use by a Mississippi mill which will convert from hydraulic pressing to filtration-extraction and will process both cottonseed and soybeans. Rated daily capacities with cottonseed will be 150 tons and with soybeans 75 tons. The new process is readily adaptable for quick conversion from one oilseed material to another, and no prepressing is required. Filtration-extraction may make it possible for smaller mills to apply solvent extraction because installations appear to be feasible with rated daily capacities as low as 75 tons for cottonseed. This capacity is in contrast to the range of 150-400 tons and more daily usually found in other solvent plants for cottonseed.

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"Communism has suffered its greatest recent loss of prestige in Europe as a result of America's effective use of surplus food," Mr. Nathan Cummings, chairman of the board of Consolidated Grocers Corporation, said upon his return from a three-month tour of Europe. He said he has seen in recent weeks a marked effect in European thinking as a result of President Eisenhower's foreign policy. Commenting upon present-day food retailing methods in Europe, Mr. Cummings observed that "America's efficient food distribution pattern, mass production and modern merchandising methods, are highly praised everywhere in Europe." He reported that "European businessmen readily give lip service to the adoption of similar food distribution techniques in their own countries," but that "cartel groups and selfish business interests which are firmly entrenched strongly oppose any change in the status quo and, as a result, little real progress has been made toward improving food distribution in many foreign countries. He pointed out Switzerland, with its large, American-type supermarkets, as an outstanding example of the kind of improved food retailing methods that could be accomplished in a healthy, competitive atmosphere in Europe; Mr. Cummings also stated that American food interests should undertake a more aggressive sampling program in foreign countries with those products in which we have a surplus and which are not the customary diet of the people in those nations.

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In response to urging by civic, industrial, and educational agencies in New England seaboard cities, new four-year undergraduate programs leading to the bachelor of science degree in fisheries technology and in food management will be set up at the University of Massachusetts this fall, according to Dr. Dale H. Sieling, dean of agriculture and horticulture. Both curricula will be administered by the food technology department, headed by IFT member Dr. Carl R. Fellers. The food management course will be separate from a two-year nondegree course now offered by the same department. At present, the only Fisheries School in the country is located on the West Coast at the University of Washington.

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The York Report, a monthly analysis of business trends issued to manufacturers by the York Engineering & Construction Co. and York-Gillespie Mfg. Co., 39th St. & Allegheny Valley R. R., Pittsburgh 1, Pa., devotes its July issue to an analysis of the current outlook for commercial use of atomic energy and of private enterprise's prospective role in the atomic energy program.

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Number 89 in the Marketing Series published by the American Marketing Association is entitled, *Markets and Marketing Techniques*, and consists of six papers presented at the recent Marketing Conference of the AMA held in New York City by a trade publication publisher, advertising agency market researcher, manufacturer, department store executive, grocery chain executive, and Government economist. The 48-page booklet can be obtained by sending $1.00 if an AMA member or $1.25 if a non-member to the American Management Association, 330 W. 42nd St., New York 36, N. Y.

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Two notes from the USDA'S Bureau of Agricultural and Industrial Chemistry, 2100 Robert E. Lee Blvd., New Orleans 19, La. The first concerns the finding that addition of about three per cent yeast or oat flour to candies containing dairy butter keeps them fresh more than three times as long as candies not made in this way. Adding yeast or oat flour for this purpose does not usually affect candy flavor, it is reported. Practical results and applications of this cooperative research are described in a recent publication, AIC-347, "Antioxidants—Research Summary No. 1," obtainable from the Southern Regional Research Laboratory at the above address or the Bureau of Agricultural and Industrial Chemistry, Washington 25, D. C.

The second USDA item concerns a recent report by Harry S. Autrey on rice milling research conducted in the pilot plant of the University of Arkansas' Institute of Science and Technology under a contract with the USDA. This research indicates that humidification of the air in aspirators and elevators or in the milling room at 70-80% relative humidity gives increases in yield of head rice as much as six per cent above normal yield at lower humidities. Where humidification of the entire milling room or of elevators is not feasible or economical, humidification of the aspirators is more critical than of any other unit, according to the findings. For further information write Mr. A. M. Altschul at the Southern Regional Research Laboratory, 2100 Robert E. Lee Blvd., New Orleans, or W. W. Grigorieff at the Institute of Science and Technology, Fayetteville, Ark.

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A pre-publication release from the Food Protection Committee, Food and Nutrition Board, National Research Council on "The Safety of Polyoxyethylene Stearates for Use as Intentional Food Additives" summarizes evidence, available to date, concerning polyoxyethylene stearate-type emulsifiers together with an evaluation of the significance of these facts with respect to the question of safety. The conclusion reached is that polyoxyethylene stearate has not been demonstrated to be safe for use in foods under all patterns of dietary consumption and for all segments of the population. Formal publication will be announced by the National Research Council, National Academy of Science, Washington, D. C.

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The little-known but very interesting story of Kosher Meat Processing is the subject of interest in the April-May issue of Armour's *Analysis*, published by Armour's Livestock Bureau, Chicago, Ill. Profusely illustrated, the eight-page article brings to light nearly every facet of this ancient-modern religious procedure.

An eye-pleasing 20-page brochure, *Sugar in Cake Baking*, by William E. Broeg, has arrived from Sugar Information, Inc., 52 Wall St., New York City. Designed to aid the baking industry in expanding the market for cakes through superior products, the brochure defines sugar in its various forms and explains its proper use for optimum quality in cakes, icings, and fillings.

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Summary of Treatment Methods for Slaughterhouse and Packinghouse Wastes, by Donald D. Gold, has been issued by the Engineering Experiment Station, The University of Tennessee, Knoxville. Bulletin No. 17 covers such subjects as Quantity and Content of Wastes, Recovery Methods, Experimental and Pilot Plant Treatment of Wastes, Treatment of Wastes at Small Slaughterhouses and Packinghouses, and Treatment of Waste for Large Packinghouses. Examples are numerous and the booklet is generously illustrated and refer-

(Continued on page 30)

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FOOD INDUSTRY TOPICS

(Continued from page 28)

enced. For copies write the associate director, Engineering Experiment Station.

. . . *things new under the sun*

"The ideal food solvent, preservative, and humectant," is the description accorded its Propylene Glycol U. S. P. by Celanese Corporation of America, which directs the attention of food technologists to the unusual odor-free quality and blandness of the product. Food processors, flavor makers, and food packaging suppliers who are interested in obtaining a free evaluation sample or specifications can do so by writing Celanese Corporation of America, Chemical Division, 180 Madison Ave., New York 16, N. Y.

◆ ◆ ◆

A salting revolution is starting in the canning industry according to Morton Salt Company, 120 S. LaSalle St., Chicago 3, Ill. Cause of all the furore is the company's Brinemaker Model E. The Model E enables the canner to use high grade, high purity, low cost, Morton Evaporated "999" salt (over 99.9 percent pure sodium chloride) in brine form throughout his plant, bringing the salt from transport to storage, to brine tank, to brine in one easy operation. The brine thus obtained can be piped throughout the plant and will be at the operator's disposal whenever it is needed at the rate of up to 800 gallons of saturated brine per hour. For further information on the Model E or other Morton services contact Mr. Thos. J. O'Dea at the company's Chicago office, address above.

◆ ◆ ◆

National Research Corp., 70 Memorial Drive, Cambridge, Mass., sends in word of new equipment and a new production method developed by the company. NRC Rotary Gas Ballast Pumps, developed jointly by NRC and E. Leybold's Nachfolger of Cologne, Germany, are mechanical rotary high-vacuum pumps unique in their ability to pump condensable vapors without contamination or loss of pumping capacity. The need for oil treating units is eliminated and oil consumption and inventory requirements are greatly reduced, according to the company. The pumps are offered in single-stage units and combination units of varying capacity. The NRC Mix-and-Settle Extractor, developed in the laboratories of Penn State College and manufactured under license from Standard Oil Development Co., is offered with as many as 30 stages and is expected to be of value for product and process research, development, and commercial production in the organic chemical, pharmaceutical, and fine chemical fields. The new NRC processing method concerns the production of cast shapes of titanium metal. Castings of complex shape weighing up to several pounds have been made. Carbon, oxygen, and nitrogen content are reasonably comparable with commercial wrought titanium, and the surface attainable is equal to that of good sandcast metals. National Research Corporation is now under contract to supply pilot titanium castings to the US Army Ordnance Corps.

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Merchandising horizons have been considerably widened with the introduction of new divided polyethylene bags, according to Plastic Packaging Co., 730 N. Franklin St., Chicago 10, Ill. The new "2-in-1" bags permit introducing new or tying-in slow-moving products with established lines and promote joint sales of kindred lines in the food and drug fields. For example, popcorn and shortening, spaghetti, sauce and cheese, or various baking ingredients can now be marketed together. Made of pure polyethylene, the bags are reportedly water- and air-tight, free from all types of additives such as plasticizers and stabilizers, unaffected by temperatures from minus 75° F. to plus 185° F., odorless, tasteless, non-toxic, will not crack, split, or run, and will not adhere to the products packaged or to varnished or lacquered surfaces. (Not bad!)

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Techniflex Corp., Port Jervis, N. Y., announces development of a line of industrial photo-relays and photometers suited to a wide variety of laboratory research and industrial control duties. The photometers are available in models specifically adapted to the following services: measurement of solution concentration by the monochromatic light method; film densitometry testing; ultraviolet radiation intensity measurements, gas analysis, and gas detection by the ultraviolet absorption method; lighting intensity comparison measurements; flash intensity measurements; dust, soot, and smoke intensity measurements; flash duration and light exposure timing measurements; color-matching and opaqueness measurements; liquid turbidometry testing; motor rotary machine speed testing (high sensitivity tachometer duty); high temperature measurements by the glow color method; and counting measurements. The photo-relays are available in models specifically designed for these applications: timing control; response to specific machine speeds; dust, soot, and smoke control; turbidity control and alarm work; exposure control in X-ray, ultraviolet, infrared, and other related work; safety alarm in danger areas; temperature control; control and alarm duty in connection with solution concentration; control and alarm duty in detecting gases or analyzing gas mixtures; glow temperature control; counting control; color-matching control; camera control in registering sparking and periodic flashing; and, camera aiming control. Write the company's Instruments Division for further information.

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High-speed computation services, performed automatically on the Burroughs Laboratory Computer—Model 1—are now available to business, manufacturing, trade, and scientific organizations at the Philadelphia Research Center of Burroughs Corporation (formerly Burroughs Adding Machine Co.). Recent test problems for outside organizations have included turbo-engine design and performance calculations; pipe stresses for chemical processing plants; optical ray tracing; antenna calculations; and statistical correlations. An expanded programming staff now permits the handling of exploratory problems for other business, manufacturing, trade, and scientific groups which wish to evaluate the use of electronic digital computers. Time required for an addition in the computer is 17/1000 second; for multiplication, 50/1000 second. Inquiries concerning the Burroughs Computation Service may be addressed to the Electronic Instruments Division, Burroughs Research, 511 N. Broad, Philadelphia 23, Pa.

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High speed filling of vials and small containers up to 4½ ounces in size with oils, suspensions, concentrated solutions, and aqueous solutions is possible with a new, multiple type, electronic vial filler tradenamed "Filamatic Add-A-Unit" and produced by National Instrument Co., 5005 Queensbury Ave., Baltimore 15, Md. According to information received, any number of Add-A-Units may be operated together in tandem; all units operate in perfect synchronization and removal of any unit for servicing does not affect the operation of the others. Production rate can be altered by simply adding or removing units. However, only one operator is required regardless of number of units in use. Moreover, the volume delivered by each unit can be adjusted with micrometer accuracy independently of the other units. The Filamatic Add-A-Unit takes only minutes to set up and hence is equally suited for long or short production runs. The manufacturer adds that initial cost is low and maintenance is negligible.

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A rate-of-rise thermostat designed to control the rate of heating and prevent hazardous temperature overshoots in fast warm-up systems has been developed by Fenwal Inc., Ashland, Mass. Known as the rate-of-rise Thermoswitch, the unit, when used in any type of heated system, controls the rate of heat output during the warm-up period and aids substantially in bringing the system up to the desired temperature without danger of overshoot. Rate-of-rise controls of this type are also useful in

(Continued on page 32)

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FOOD INDUSTRY TOPICS

(Continued from page 30)

monitoring processes in which rate of heating must be controlled or in which temperature overshoots from a rapid heating cycle must be prevented. The unit may be used either with standard temperature controls or as a separate safety control. It operates efficiently in any ambient temperature between minus 100° F. and plus 550° F., and, like the company's standard temperature-controlling Thermoswitch, has excellent shock and vibration resistance. An important construction feature is that the unit is hermetically sealed for trouble-free response and long life.

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A very handy and attractive computing tool, called the Durethene Polyethylene Bag Weight Calculator, is offered readers free of charge by the Durethene Corp., 1859 S. 55th Ave., Chicago 50, Ill. The Calculator quickly computes the number of pounds of polyethylene film required to make 1000 bags from any given width and gauge of plain or gusseted tubing. It is unique in that one side contains a scale for tubular film and the reverse side computes the poundage required for flat film. (Bags made from flat film require an overlap for the back seam and therefore additional poundage is required.) Copies of the new tool may be obtained by writing the company's Sales Department at the above address.

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New avenues of application for analytical ultracentrifugation have been opened by the new Spinco Synthetic-Boundary Ultracentrifuge Cell which permits measuring the sedimentation constant of a slow component moving in the presence of a fast component. In effect, the instrument extends the range of ultracentrifugal analysis downward in the macromolecular region from molecular weights of about 10,000 (the former practical lower limit) to about 500. Principle of the new device depends upon the layering of one solution, the supernatant, over the mixture under study, thus producing a boundary away from the meniscus. Or, in the case of two components, layering a solution containing only the fast component over a mixture of the fast and slow components. This procedure artificially creates a boundary of the slow component in the presence of the fast component, and measurements of the movement of this boundary are made by conventional optical methods. For complete descriptive information on the new Synethetic Boundary Cell write Specialized Instruments Corp., 704 O'Neill Ave., Belmont, Calif.

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An efficient new pressure feeder now available makes it possible to feed bulk materials into and out of a pressure or vacuum chamber without stopping the processing operation. This machine, the Collins-Adey Pressure Feeder, is mechanically operated and moves material by gravity or mechanical means through an intermediate pressure lock from one pressure to another. Balance ports equalize pressure between the several adjacent sections, thereby making it possible to feed unprocessed material into the production flow, while moving the processed material along the line. Opening of the gates and chokes is automatic, and, when mechanically closed, gates are locked and sealed against loss of pressure or vacuum. The unit, fabricated from either carbon or stainless steel, will continuously move materials from a high vacuum to atmospheric pressure or feed at atmospheric pressure to compressions as high as 10,000 psi. Further particulars are available from John T. Collins & Co., 21 Maple St., Summit, N. J.

A new line of nine "substance" canned items produced by Dorset Foods, Ltd., will contain a detailed breakdown of contents on the label for the benefit of special diet consumers. The five soups and the four meat and poultry dishes in the line have printed on their labels such information as the amount of carbohydrates, protein, fat, ash, total solids, moisture, and crude fiber contained, as well as calories per can and the sodium content. Furthermore, each of the nine items will provide a substantial meal, in contrast to the rather limited choice of canned dietetic fruit juices and vegetables hitherto available. The company reports that more varied fare will be added to its line in the near future.

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To gain highest possible efficiency in its compact Ultra-Aire Space Filters, Mine Safety Appliances Company, Pittsburgh, Pa., fan-folds the filter paper by machine and uses special V-shaped corrugated paper spacers instead of the standard round-fold corrugated paper. Blackening of the filter paper by dirt particles after long use leaves only fine white lines of contact with the corrugation folds, indicating about 90% exposure for air flow through the paper. Ultra-Aire filters will take tobacco smoke (.05 to 0.1 micron particles) out of air passing through them. The filter medium is a dry and moisture-proofed, porous, matted paper made of small diameter fibres. Four standard sizes have capacity ratings of 1000 cu. ft. per minute, 500, 50, and 35 cfm. at an initial resistance of one inch of water. The filters are used for health protection (against radioactive dusts, bacteria, and industrial dusts and smoke) and for protection of products during manufacture (such as foods, beer, textiles, pharmaceuticals, photographic film, delicate instruments, paint, and plastics).

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The Bristol Company, Waterbury, Conn., has developed a new multiplexing transmitting and receiving system for use with the company's Metameter Telemeters. With this equipment, up to 15 readings (either pressure, vacuum, water or liquid level, flow, temperature, static and differential pressure, motion, voltage, current, and totalized load) taken at separate locations or areas can be transmitted any distance to Metameter receiving instruments over a single circuit. This results in a saving in the cost of circuits since it eliminates need of separate circuits for each reading transmitted. Readings can be transmitted over telephone circuits, carrier current, radio (including microwave, VHF, and UHF), private wires, and low rental cost telemeter circuits (15 CPS channels) available from the telephone company. A complete description is contained in the free booklet available by writing the company.

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A new stapling hammer which drives a new wider staple has been announced by Bostitch, 1010 Mechanic St., Westerly, R. I. Model H2BR uses a staple of .102" × .030" wire with ⅜" leg length. This staple is twice as wide as those used by other medium-duty stapling hammers. The increased surface contact helps to prevent paper materials from tearing away from the staple. One hand and one blow drive the staple all the way home, even into hard woods. Eastern list price of this new tool is $17.50.

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A new process for printing photographic effects on cellophane has been developed by the Lassiter Corp., according to Mr. J. Hanes Lassiter, president. The process, called Lassitone, has already been proven successful in actual production runs of cellopane wrapping for two soft goods items and a bread, Mr. Lassiter said. Several other items are currently in production. The new method permits reproduction of half-tone photos or art on cellophane without the preparation of costly printing cylinders necessary for rotogravure reproduction, thus allowing smaller users of cellophane, who ordinarily buy in quantities of one to three thousand pounds, to use photographic art for the first time on cellophane bags, wraps, and envelopes. One of the most important advantages of the new printing process is that it permits production of packages of various sizes from the same set of half-tone printing plates. Minor copy changes in designs containing photographs can be made with ease under the new process without making complete new plates. This

(Continued on page 38)

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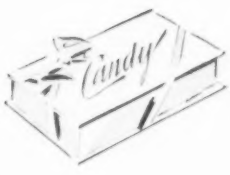

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Calcium Phytate

SEQUESTERING AGENTS—
For stabilizing foods such as vinegar & vegetable oils.

Phytic Acid (40% Solution)

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EMULSIFIER AND STABILIZER — FLAVOR ENHANCER

Other quality food products made by Staley from corn and soybeans include

Corn Syrup: "Sweetose"
Intermediate Conversion
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Food Starches
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Please send me data and prices on following products:

_____ _____
_____ _____
_____ _____

Name _____

Firm _____ Position _____

Address _____

City _____ Zone ____ State _____

FOOD INDUSTRY TOPICS

(Continued from page 32)

permits a small cellophane user to have a "family" design for all of his products and make appropriate changes in copy for each item marketed under the same trade name and common logotype.

. . . *the literary corner*

Just off the press is the latest (July 1953) catalog and price list of Essential Oils, Aromatic Chemicals and Certified Colors published by Dodge & Olcott, Inc., 180 Varick St., New York 14, N. Y. Containing 20 pages of price listings, descriptions, and related information, the new catalog includes concentrated citrus oils, terpeneless oils, floral waters, absolutes and concretes, oleoresins, resinexes, balsams, gums, animal fixatives, tinctures, ambreine, aromatic specialties, ionones, iraldeins, methyl ionones, and vanilla aromatic chemicals. Copies are available upon request to D & O at the above address.

Results of research on vitamin retention and palatability of a group of eight fresh and frozen vegetables in large-scale food service have just been released by the College of Home Economics at Cornell University in the form of a 48-page bulletin entitled, "Vitamin Retention and Palatability of Certain Fresh and Frozen Vegetables in Large-Scale Food Service." Vegetables used in the project were fresh broccoli, Brussels sprouts, cabbage, cauliflower, rutabagas, spinach, and frozen broccoli, lima beans, and peas—all sources of vitamin C (ascorbic acid), riboflavin, and thiamine. The study was made to determine how much of these important vitamins was retained under various methods of quantity cooking. One of the key findings was that vegetables, when boiled either in an institutional steam-jacketed kettle or in a regulation kettle on a range, held over 50 percent of the three vitamins and rated good for taste. Cooked in the steamer, without water added, they retained more vitamins but didn't rate as high in palatability tests. Spinach stayed greener when cooked in water until just tender. Fresh spinach and frozen broccoli, it was found, lost more of the vitamins when cooked in 20-pound lots as compared with five-pound lots. In the institution steamers, all the vegetables lost palatability as steam pressures were increased. At 2½ and five pounds pressure, they were fairly acceptable, but considered not palatable when cooked at higher pressures. Nearly all the vegetables lost some vitamin C when held warm for 15 minutes—a loss which increased for all types of heating equipment the longer the vegetables were held. For the complete report, write for Bulletin 891 to the Cornell University Agricultural Experiment Station, Ithaca, N. Y.

From the Industrial Division of Minneapolis-Honeywell Regulator Company, Wayne and Windrim Aves., Philadelphia 44, Pa., comes a catalog, a bulletin, and a data sheet. The 48-page catalog, *Buyers Guide, 100-5* (newly revised), describes and illustrates Honeywell pyrometer supplies. All general thermocouple assemblies and components are listed, as well as many special purpose items. Prices and several pages on selection, care and application of thermocouples round out the publication. Bulletin 1210 covers the Brown Portable Potentiometer and Brown Portable Potentiometer Pyrometer, with direct reading temperature, millivolt, and extended range scales. Wiring diagrams, instructions, specifications, and special features are also included. Information Data Sheet 10.1-3 furnishes information on the use of Honeywell *ElectromiK* recorders in conjunction with RdF-STIKON (Ruge-de Forest Inc.) resistance thermometer elements for the rapid and accurate measurement of surface temperatures in the range of minus 100° F. to plus 400° F., even under extremely restricted space limitations. Elements are cemented to any smooth surface, and temperature read directly. For any of this literature write Station 64 at the address as given above.

The *Monthly Bulletin of Agricultural Economics and Statistics*, published by the Food and Agriculture Organization of the United Nations, Rome, Italy, contains, in the July issue, 60 pages of information and tabular material on crop production, trade, and prices throughout the world. The *Bulletin* costs 50c per single copy or $5.00 per year and may be ordered (along with any other FAO publications) through the U. S. sales agent—Columbia University Press, International Documents Service, 2960 Broadway, New York 27, N. Y.

The Refrigeration Research Foundation, 200 Midland Bldg., Colorado Springs, Colo., announces completion of the Foundation's *Commodity Storage Manual*. All Foundation members as well as everyone who participates in any way in decisions on how to store and handle commodities in a refrigerated warehouse are invited to avail themselves of the information contained in the *Manual*. Price is $11.00 per copy.

Design and cost-cutting values of double-enveloping worm gear sets and speed reducers in all types of food and chemical processing equipment are described and illustrated in a new four-page, two-color brochure now available from Cone-Drive Gears, Division Michigan Tool Co., 7171 E. McNichols Rd., Detroit 12, Mich. "Cone-Drive Gears in Food and Chemical Processing," contains typical applications of Cone-Drive double-enveloping worm gear sets and speed reducers in equipment for petroleum refining, chemical processing, food production and packaging, bakeries, and plastics and resins production. Among these are butter churns, agitators for chemicals, regulators for flow of liquids, solvent extractors, bakery equipment including ovens and dough troughs, ball mills for plastics and resins production and valves for petroleum refineries. For a free copy of the bulletin write the company's advertising agency, Denham & Company, 925 Book Bldg., Detroit 26, Mich.

A new 28-page, four-color general catalog, No. 553, covering the company's complete line of high-pressure tube and pipe fittings, is now available from the Flodar Corporation, 1335 E. 45th St., Cleveland 3, Ohio. In addition to descriptions, cutaway drawings, photographs, engineering tables, and complete specifications on all Flodar fittings, the catalog contains many helpful facts regarding selection of proper tubing for a given application, bending of the tube, instructions for making perfect joints, etc.

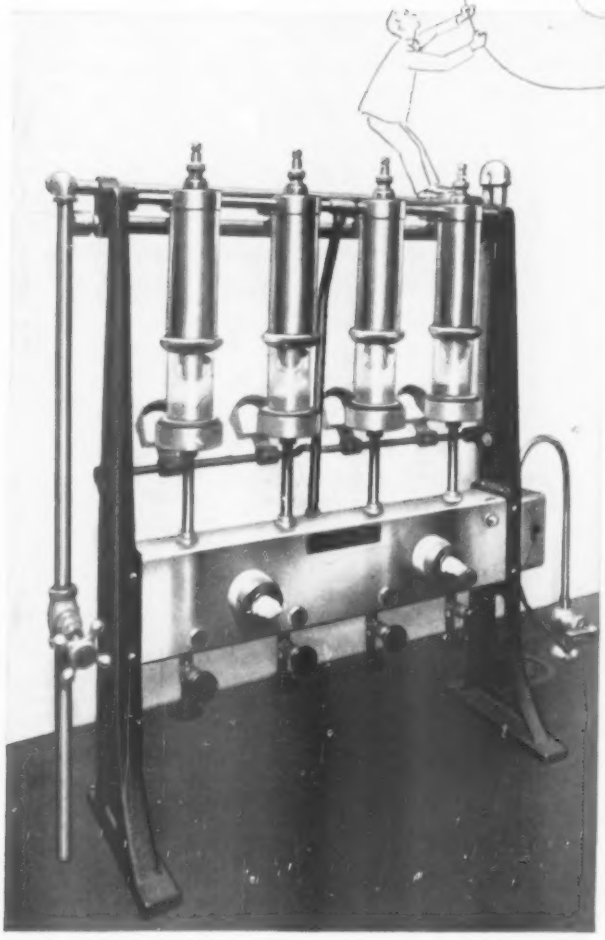
From the Public Relations Department of Foster D. Snell, Inc., 29 W. 15th St., New York 11, N. Y., comes a revised eight-page booklet on Snell Packaged Unit Spray Dryers. The booklet points up the savings brought about through use of spray dryers and answers questions concerning their use. It is one of a series of sixteen booklets on Snell products and services available free of charge upon request to the organization.

"A Proposal for Managements with Vision" is the title of a new brochure published by CDC Control Services, Inc., 400 S. Warminster Rd., Hatboro, Pa., to describe a unique, specialized engineering service for making plant operations automatic. The service—the first of its kind—consists of consultation, analysis, design, and construction in the automatic control field. Write the company for a gratis copy.

(Continued on page 40)

How Griffith's Extraction Process Assures Better-Flavored Products

PEPPEROYAL AND SOLUBLIZED SEASONINGS



True Flavors in Smooth Mellow Blend
—The Taste of Sunshine All the Time

In this age of scientific miracles, Griffith's staff of chemists enables you to change a good product into a delicacy—simply by changing to PEPPEROYAL or SOLUBLIZED SEASONINGS.

Griffith's Solublized Seasoning Formulas set a new high standard of flavor potency, purity and uniformity. By a special extraction process,* Griffith controls flavor quality. Blends spice extractives scientifically—with predictable, dependable results for spice users!

Change from the old to the new *sunny-day* flavor quality—change to PEPPEROYAL or SOLUBLIZED SEASONINGS.

Write us for details.

* Patent Applied For.

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LOS ANGELES 58, 4900 Gifford Ave. • TORONTO 2, 115 George St.

FOOD INDUSTRY TOPICS

(Continued from page 38)

A unique set of "Fact Sheets" describing the background of Continental Can Company, Inc., and its various divisions has been received from the company. The new Fact Sheets are revisions of similar material previously released, and bring the Continental story up-to-date. Titles are as follows: Fact Sheet A—"Growth and Structure" (12 pp.); Fact Sheet B—"Metal Container Manufacturing" (9 pp.); Fact Sheet C—"Fibre Drum and Paper Container Manufacturing" (9 pp.); Fact Sheet D—"Crown and Cork Manufacturing" (5 pp.); and Fact Sheet E—"Research and Engineering" (17 pp.). Companies or individuals who have need of these fact sheets may obtain them by writing Continental Can Co., Inc., 100 E. 42nd St., New York 17, N. Y.

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Professional, commercial, industrial, and technical photographers who must keep their negatives and sheet film transparencies properly filed for ready reference will find a new Kodak booklet, *Filing Negatives and Transparencies*, of considerable assistance. Based on the premise that effective negative filing systems must not only provide for the secure storage of the negatives and transparencies but must also be arranged so that desired films can be readily found, the leaflet outlines tested methods of classifying, identifying, and storing photo negatives and sheet film transparencies. The leaflet contains 20 pages and is liberally illustrated with photographs on all important points. A free copy may be obtained by writing Sales Service Division, Eastman Kodak Company, Rochester 4, N. Y.

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The June-July 1953 issue of *Armour's Analysis*, published by Armour's Livestock Bureau, Chicago 9, Ill., is devoted to the vital and fascinating subject of meat preservation. All the principal methods of preservation—including refrigeration, drying, salting, smoking—plus various supplementary methods come under consideration. The article concludes with this interesting thought: "Down through the centuries, meat has played a major role in determining the destiny of nations. . . . Meat eaters took over the great trade routes. The grain-growing Persians lost to the meat-eating Greeks, and the pastoral Goths from the North conquered Rome. The most vigorous colonizers and the more advanced in the industrial achievements of modern times have been the heaviest consumers of meat." (Fruit salad, anyone?)

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The July 1953 issue of *Fatty Acid News Digest*, published by the Fatty Acid Division of the Association of American Soap & Glycerine Producers, Inc., 295 Madison Ave., New York 17, N. Y. (whew!) contains a number of news tidbits on Plants and Processes ("The Outlook for Inedible Fats and Oils"), Products and Applications ("Present Problems and Future Trends in Lubrication"), and Chemistry and Research ("Sugar and Dextrose in Aqueous Glycerol").

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A reprint from the July 11 issue of *Business Week*, sent in by Arthur D. Little, Inc., tells the story of the recent important change in the ownership of the company. The controlling stock interest, willed to Massachusetts Institute of Technology by co-founder Arthar D. Little upon his death in 1935, has been purchased by the company's employeers' retirement trust, representing the more than 700 employees, for the sum of $1,300,000. According to company president Earl P. Stevenson, this apparently is the first time that scientists working for a large private research organization will have a major stake in the financial returns from their investigations and developments.

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The *D & O News*, monthly publication of Dodge & Olcott, Inc., 180 Varick St., New York 14, N. Y., devotes its August issue to three highly readable articles: "Perfuming the Aerosols" explains the special perfume problems involved in exploiting this expanding new market; "Flavors for the Military" traces the growth of the realization that palatability is a full partner of nutrition in military rations; and "Growth of a Billion Dollar Industry" is a quickie on the U. S. Toilet Goods Industry.

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"Read all about it"—the recent National Confectioners' Association Convention, that is, in the current *N. C. A. Bulletin*. Included are feature articles, digests of speeches, question and answer discussions, and photographs aplenty. For copies, write National Confectioners' Assn., 221 N. LaSalle St., Chicago 1, Ill.

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A new data bulletin (identified as publication No. 40), published by Varian Associates, 536 Hansen Way, Palo Alto, Calif., illustrates and describes the Varian Model V-4300 High Resolution n-m-r (nuclear magnetic resonance) Spectrometer. Principally applicable to compounds containing hydrogen or fluorine, the new instrument can detect differences in the n-m-r structural spectra of isomers. Comparison of resulting oscilloscope traces against those obtained from known fluorine compounds makes it possible to identify structure in the two isomers. By addition or substitution of various available radio-frequency units, the Model V-4300 Spectrometer can be applied to studies of many other isotopes. In operation, the high-resolution spectra are observed and either recorded on a strip chart or photographed from an oscilloscope screen. Related units utilized include a magnetic field system provided by standard Varian electromagnets, regulated magnet power supplies, and voltage regulator. The bulletin includes data on basic operating characteristics; general arrangement of sub-units encompassing the probe, the radio-frequency transmitter and receiver, sweep device, power supply, and oscillograph.

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A 12-page bulletin (Bulletin No. P1255), available from The Bristol Co., Waterbury 20, Conn., describes Bristol Electronic Dynamaster Recording Potentiometers now available in the from of Time-Temperature Program Controllers. The new program controllers regulate temperature according to a predetermined schedule of changing values. Any desired program, such as a heating, soaking, and cooling cycle can be accurately maintained. The desired schedule of temperatures is prescribed by the contour of a transparent plastic cam. The same controller can be used to maintain any number of different temperature programs, since cams of different contour are easily cut and interchanged. The instruments employ an electronic control system with proportional input action optionally available.

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"Teflon" in other applications is the subject of an eight-page catalog offered by Ethylene Chemical Corp., Summit, N. J. The catalog includes Teflon product lists and price lists, and offers stress relieved as well as high tensile molded rods, tubes, and sheets; extruded rod; extruded tubing; electronisized rod; custom moldings, machined parts, shaved tape, etc. Techniques for matching Teflon are described and engineering services are

offered. Teflon applications and properties are listed with charts, tables, and diagrams.

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The extent to which double-enveloping worm gearing has helped improve design, performance, service-life, and saleability of all types of equipment in recent years is profusely illustrated in a 36-page, two-color booklet now available from Cone-Drive Gears Division, Michigan Tool Company, 7171 E. McNichols Rd., Detroit 12, Mich. Going beyond the usual manufacturer's claims, Bulletin CD-173 entitled, "Cone-Drive Gears at Work in Industry," documents 93 successful applications in 20 different industrial classifications ranging from agricultural to zinc mining equipment. Of additional interest to manufacturers is the fact that standard Cone-Drive Gears are available in a wide range of sizes. For a free copy of this very substantial brochure, write the company at the address given above.

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A new bulletin describing a new extruded rigid polyvinyl chloride pipe and tubing in a wide range of sizes and a full line of fittings has just been issued by Alpha Plastcis, Inc., 14 Northfield Rd., West Orange, N. J. Detailed physical properties, bursting strengths, and other important data are included. The new pipe and tubing are made of "Alpha Forty," a special compound of a vinyl chloride polymer of high molecular weight. This material is processed without the aid of plasticizers or co-polymers and is distinctly different from so-called "hard vinyls" which are produced by reducing the plasticizer content. As such, "Alpha Forty" retains the excellent unmodified properties of straight p.v.c., and produces an extremely hard, tough, and rigid product with outstanding chemical resistance.

. . . meeting hall and conference room

Grocery Manufacturers of America, Inc., will hold its 45th Annual Meeting in New York at the Waldorf-Astoria Hotel on November 9-10-11, according to Mr. Paul S. Willis, GMA president. The first day's meeting will be a closed session for GMA members, with the sessions on November 10-11 open to the public. There will be special luncheon sessions on both days, and the annual dinner is scheduled for Wednesday evening, November 11. Based on past experience, attendance at the 1953 convention is expected to exceed all previous records. "Over the years," Mr. Willis said, "the GMA Annual Meeting has become increasingly a complete grocery industry conference. Attendance has grown to include not only executives of most leading grocery manufacturers, but leaders from agriculture, Government, grocery distribution, and related industries."

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On September 15, the candy industry of Philadelphia, with an assist from the candy industry in Pennsylvania and nationally, conducted a "Sanitation Seminar" at the Penn Sheraton Hotel in Philadelphia—the first of its kind to be held by the industry in the East. The seminar, chairmained by Fred B. Jacobson, entomologist and sanitarian of Stephen F. Whitman & Son, Inc., Philadelphia, was devoted both to the technical and laboratory aspects of sanitation and to the more practical aspects, with an attempt being made to point the program directly toward operating personnel. An evening dinner featured speeches by Mr. Robert C. Stanfill, chief, Philadelphia District of the Food and Drug Administration, and Mr. Wm. S. Hagar, deputy secretary of Agriculture and chief of the Bureau of Food and Chemistry, Commonwealth of Pennsylvania. Mr. Hans F. Dresel of Felton Chemical Company served as vice-chairman of the seminar.

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The Plant Maintenance Show, held for the past four years in the East, will be held at Chicago's International Amphitheatre, January 25-28, 1954, according to Clapp & Poliak, Inc., New York, producers of the exposition. At the same time, it was

FOOD INDUSTRY TOPICS

disclosed that the name will be changed to the Plant Maintenance & Engineering Show. It will be one of the five largest annual industrial shows to be held anywhere in the country. The Chicago exposition will cover more than 100,000 square feet of exhibit space, about one-third larger than the 1953 show and about six times the size of the first exhibit. Three-hundred-and-ten companies already have been assigned space, and the final total is expected to reach 350. Concurrently with the show, the Plant Maintenance & Engineering Conference will be held at the Conrad Hilton Hotel. Advance registration cards may be obtained from Clapp & Poliak, Inc., 341 Madison Ave., New York 17, N. Y.

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CHILI PEPPERS GET CLOSE SCRUTINY OF GENTRY SALES REPRESENTATIVES FROM THROUGHOUT THE NATION AT OXNARD, CALIFORNIA, DURING WEEK-LONG COMPANY SALES CONFAB EARLY IN AUGUST. THE TOUR INCLUDED INSPECTION OF GENTRY'S ONION AND GARLIC FACILITIES AT GILROY, CALIFORNIA, AND A SERIES OF MEETINGS IN THE COMPANY'S GENERAL OFFICES, LOS ANGELES. LEFT TO RIGHT: JACK STUBBLEFIELD, DR. ERIC TODD AND H. E. PHILBROOK, OXNARD; MARTIN KRAHAM, CHICAGO; JOE FARRELL, NEW YORK; W. W. KEARNEY, CHICAGO; MAX SHAPIRO, NEW YORK; LLOYD BELLISIME, VICE PRESIDENT, LOS ANGELES; CARL SHERROD (KNEELING) CINCINNATI, AND EVERETTE VARNER, KANSAS CITY. EXTREME REAR: DR. ARTHUR N. PRATER, GEORGE E. CLAUSEN, JR. AND DR. J. B. MOSTER, LOS ANGELES, AND T. E. CUCCIO, OXNARD. THE THREE MEN PARTLY OBSCURED ARE TOM M'GILL, CHICAGO; OSCAR SCHEK, NEW YORK, AND NAT READ, DALLAS.

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Over 100 registrants from educational institutions, research organizations, and all types of industrial establishments attended a week-long course in X-ray diffraction August 24 through 28 at the Sir Francis Drake Hotel in San Francisco. The first West Coast educational project of this type, the course was sponsored by the Research & Control Instruments Division, North American Philips Company, Inc., 750 S. Fulton Ave., Mt. Vernon, N. Y., and its western representatives. The school will be held annually as a result of many requests from scientists in the area who asked that the company duplicate the program which has been so successful in the New York territory during the past seven years. Philips charges no registration fee and leading scientists cooperate by lecturing and demonstrating latest X-ray diffraction techniques using the most modern equipment. The company, through its X-ray Diffraction School, has pioneered in establishing X-ray analysis as a vital tool for production control in all types of plants in this country. The same idea, reports the company, underlies the Philips Application Laboratory which is open to interested parties the year 'round in Mount Vernon, N. Y. Here, any company may have its peculiar problems subjected to the non-destructive X-ray analysis methods and trained technicians render unbiased reports as to the capabilities and limitations of the X-ray instruments with respect to the particular problems under study without charge.

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At the recent 124th National Meeting of the American Chemical Society, held in Chicago September 6 through September 11, some of the most interesting and well-conceived papers were presented at the various symposia of the Division of Agricultural and Food Chemistry, under the chairmanship of Dr. Arthur N. Prater. The symposia were concerned with the following problem areas: Deterioration in Food Fats; Developments in the Chemistry of Fats and Oils; Technology of Food Packaging Materials; Rodenticides; Fermentation Process Control; and Nontherapeutic Uses for Antibiotics.

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Although it's a little late now for any readers to plan to attend, we do want to mention the Third Annual Convention of the Australian Regional Sections of the IFT, held May 13, 14, and 15 at Maroondah Lake Hotel, Healesville, Victoria, Australia. This was the first convention to be held since the formation of the two Australian Regional Sections (Northern and Southern) and featured such distinguished speakers as Dr. I. Clunies Ross, chairman of executive, C.S.I.R.O., and Professor Sir Stanton Hicks, University of Adelaide. Yeast in brewing and baking and heat penetration studies were the subjects of several papers presented at the meeting.

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Close to 50,000 business executives from all parts of the United States and a number of foreign countries are expected to participate in meetings to be sponsored by the American Management Assn. during the 1953-54 fiscal year. For that period the association has scheduled 12 large-scale conferences in eight fields of business management and a number of one-day "briefing sessions" on specific topics. Two conferences will be held in personnel, in manufacturing, in insurance, and in general management; one each will be held in finance, marketing, office management, and packaging. New York, Chicago, Philadelphia, Cleveland, San Francisco, and Atlantic City will play host to one or more of the sessions. Concurrent with the AMA's packaging conference will be its 23rd National Packaging Exposition, April 5-8 at Atlantic City. Some 280 seminars on specific business problems will be sponsored by the association at the AMA Management Center in New York and in Chicago and Detroit hotels. The five-week AMA Management Course in the basic principles, skills, and tools of management will be in session for 39 weeks. The complete program of AMA Workshop and Orientation Seminars may be obtained from the director of this activity, AMA Management Center, 330 W. 42nd St., New York 36. Brochures describing the Management Course are available from the director, AMA Management Course, 10th floor, Hotel Astor, Times Square, New York 19.

. . . *building up and branching out*

Continental Can Company's two recent acquisitions, the Benjamin C. Betner Company and Shellmar Products Corp., have been consolidated into the company's new Shellmar Betner Flexible Packaging Division. Mr. Benjamin C. Betner Jr., will be in charge of operations for the new Division, with headquarters in Mt. Vernon, Ohio, former main office of Shellmar. Shellmar Betner Flexible Packaging Division plants are located in Mt. Vernon and Zanesville, Ohio, Appleton, Wisc., Devon, Pa., Richmond, Va., Columbus, Ga., Beaumont and Paris, Texas, and Los Angeles and South Gate, Calif. In addition, there are five former Shellmar plants in Latin America and affiliates in other foreign countries.

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A new multi-million dollar industry was added to the Midwest Thursday, August 13, when Gov. Wm. Stratton of Illinois accepted the dedication of the giant new Mrs. Tucker's Foods plant at Jacksonville. In ceremonies formally opening the installation, Mr. Lamar Fleming, Jr., president of Anderson, Clayton & Co., of which Mrs. Tucker's is a division, made the

dedicatory address, which was then responded to by Gov. Stratton on behalf of the people of Illinois. Capable of handling over 600 railroad tank cars of vegetable oil at a time, the new plant is one of the largest and most modern in the world. It includes a tremendous battery of storage tanks, a hydrogen plant, a refrigeration plant, a vegetable oil refinery, manufacturing plants for the processing and packaging of vegetable oil foods and cooking fats, warehouses, maintenance shops, office space, and a control laboratory. Dedication of the plant marked the 40th Anniversary of Mrs. Tucker's Foods, an early vegetable food products pioneer whose activities had previously been confined to the South.

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Insect Control & Research, Inc., consulting entomologists and sanitary engineers, Johnnycake Road, Baltimore 7, Md., announces the opening of a Philadelphia office at 2341 Tague Ave., Glenside, Pa., to serve clients in Eastern Pennsylvania, Northern Delaware, and New Jersey. This office will be under the professional direction of Murray I. Cooper, Ph.D., graduate entomologist and sanitation consultant. The company, whose staff of entomologists, chemists, and sanitarians is well known in the food plant sanitation field, offers a complete sanitation service, including plant inspection, insect and rodent control, analyses of food materials and products, legal testimony, etc. In addition, its staff is available for entomological matters for the agricultural industry and pesticide manufacturers. For information write IFT member Eugene J. Gerberg, director, Insect Control and Research, Inc., at the Baltimore address, or Dr. Cooper at the Glenside address.

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Union Plastic Films Company, a division of Transparent Package Company, Chicago, has announced the signing of an agreement for exclusive worldwide rights to produce the famous "inner crisper" bag now being used by Salerno-Megowen Biscuit Company, Chicago, and by Megowen Educator Food Company, Lowell, Mass., in packaging graham crackers and saltines. Under terms of the agreement with Mr. George F. Salerno, inventor of the product, Union Plastic Films is authorized to produce the bags and offer them to the trade with a license to complete the food package. The "inner crisper" bag, made of saran, or other moisture-proof films, keeps crackers crisp and fresh for an extensive period. Permanently sealed at one end and unsealed but folded over at its opposite end, the bag controls the moisture content of the cracker on the store shelf to the normal three percent. While the license extends to all films, Union Plastic, a major converter of saran (made by Dow Chemical Company), said that in extensive test it was proven that the excellent moisture barrier properties of this material in a wide range of temperature and humidity conditions can be more successfully utilized in the bag packaging of crackers than the other tested films. Union Plastic Films developed the Unitronic sealing method for saran which makes large scale commercial production of saran bags possible.

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In a move designed to strengthen its supplies to the food trade and improve its services to growers, Mutual Orange Distributors of Redlands, California's second largest citrus cooperative, has today separated its fresh fruit and products divisions, Mr. Robbins Russel, general manager, announced. Under the new plan, Real Gold Company, formerly Real Gold Citrus Products, the processing and marketing division of Mutual Orange Distributors, becomes a separate organization which will conduct all business on processed citrus products under the Real Gold label—reportedly accounting for over 90 percent of the nation's orange base sales. Mutual Orange Distributors will handle the fresh fruit only. The move, according to Mr. John L. Doyle, Jr., Real Gold president, puts his company in a position to buy fruit competitively on the open market as well as from Mutual Orange Distributors "so that we can meet the constantly increasing demand for Real Gold Orange Base."

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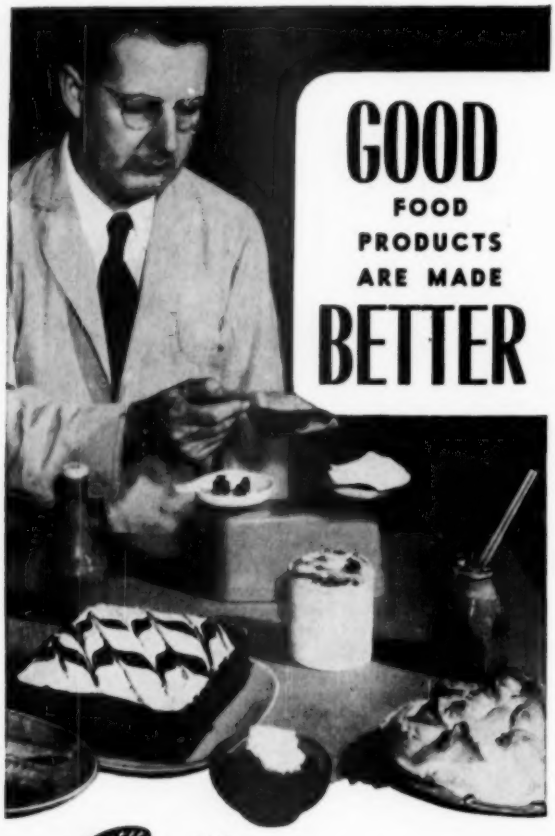
White Stokes Company, Inc., Chicago, manufacturers of ingredients for the confectionery, bakery, and fountain trade, have appointed Frederick J. Stokes, Stokes and Company, Atlanta, Ga., to handle distribution of the company's products in Georgia, Alabama, and Florida, with the exception of the Miami area.

Sustane #1-F
TRADE MARK ®

PROTECTS THE SHELF-LIFE OF YOUR PRODUCT

Sales success is no accident. That's why so many food manufacturers give their products the "stay-fresh" protection of Sustane No. 1-F . . . highest potency butyl hydroxyanisole in flake form! Prevents rancidity **before it starts** . . . gives long time unrefrigerated protection and remarkable carry-through for baked goods. It is completely and readily fat soluble, colorless and odorless. 100% active antioxidant—low in cost . . . easy to apply.

PRODUCTS DEPARTMENT
UNIVERSAL OIL PRODUCTS COMPANY
30 ALGONQUIN ROAD, DES PLAINES, ILL., U. S. A.
UOP ®



GOOD FOOD PRODUCTS ARE MADE BETTER

with SeaKem "COLLOIDS OUT OF THE SEA"*

Does your product have all the appetite and sales appeal it needs? . . . Can your manufacturing process be simplified or speeded up? . . . Has a really tough improvement problem got you ready to throw in the towel?

Then it's time right now to discover how SeaKem Stabilizers can help you.

The check list at right shows a few of the positive ways these remarkable colloids are improving dozens of items as widely varied as bakery product stabilizers, chocolate milk, dessert mixes, ice cream stabilizers, pet foods, pie fillings (fruit), puddings, sauces, sausages, and syrups.

Whatever your food product may be, if the function you are interested in is listed, it will pay you to get full information on SeaKem "Colloids Out of the Sea". For prompt, non-obligating recommendations, just write outlining your problem.

Here are a few of the functions being performed by SeaKem Stabilizers for an ever-growing list of food products:

- Binding
- Bodying
- Emulsifying
- Gelling
- Modifying
- Stabilizing
- Suspending
- Thickening
- Custardizing milk and products containing milk solids
- Improving mouth feel and flavor
- Increasing efficiency of component ingredients
- Modifying ice crystal growth
- Physical and anti-oxidant protection

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41 David St., New Bedford, Massachusetts

FOOD INDUSTRY TOPICS

A unique production-merchandising agreement between Red Star Yeast & Products Co., Milwaukee, Wis., and Charmin Paper Mills, Green Bay, Wis., will, according to Red Star president Russell D. L. Wirth and Charmin president J. M. Conway, establish volume production of torula yeast, expand facilities for its sale and distribution, and provide the research effort necessary to bring out its full potential as a food, feed and pharmaceutical ingredient. The product is derived from tree sugars extracted from wood solids otherwise unused in pulp and paper manufacturing. Unlike the more familiar active yeasts used in baking and brewing, torula yeast is not a leavening agent but is an inactive yeast of purely nutritional value. It differs from other yeasts, also, in that it is made in a continuous propagation process revolutionary to the yeast industry. For its part in the new agreement, Charmin is constructing a torula yeast producing plant adjacent to the company's Green Bay mills. The plant will have a production capacity of at least 10,000,000 pounds annually. Meanwhile, Red Star will begin researches in torula yeast with a view to developing additional new uses and a full line of products.

◆ ◆ ◆

Ekco Products Co. housewares manufacturer, has established a new industrial foil packaging section in its specialty sales division, it was announced by Mr. John G. Brooks, vice president in charge of housewares sales. The new section will be staffed by experienced engineers equipped to assist manufacturers of food and other products with their packaging, handling, and merchandising problems. According to Mr. Brooks, foilware containers have aided both production and sales in the bakery goods, frozen foods, and several other fields.

◆ ◆ ◆

By renaming its Haskell Laboratory, the Du Pont Copmany has pointed up the expansion of its basic research on industrial medicine—an outgrowth of its extensive work in toxicology. Starting from the relatively narrow base of learning how toxic certain products might be, the program has grown into a major research effort in industrial preventive medicine. In recognition of this, the name has been changed from "Haskell Laboratory of Industrial Toxicology" to "Haskell Laboratory for Toxicology and Industrial Medicine." The Du Pont scientists have been probing such secrets as the causes and effects of fatigue, basic factors that make clothing comfortable, and methods for the early determination of abnormal heart conditions, as well as investigating the toxicity of chemicals made or used by Du Pont. Despite the progress made in this work thus far, the potential for better—and perhaps longer—living lies in their hopes of things to come from their future work in the expanding program. To advance it, the Haskell Laboratory research organization will be moving into a new $2,000,000 laboratory near Newark, Del., this summer and expects to dedicate it this fall.

. . . the human element

Newly elected assistant vice president of National Starch Products Inc., 270 Madison Ave., New York City, Mr. J. F. Fitzgerald has been associated with the company since 1935 and has been closely identified with the firm's expanding starch sales to the textile, paper, and food fields. He has been manager of Starch Sales since 1948. Mr. Fitzgerald is a Lowell Textile Institute graduate, and is a member of the American Association of Textile Chemists and Colorists, National Confectioners Association, American Pulp and Paper Association, and TAPPI.

◆ ◆ ◆

A new international flavor has been added to the Flavor Department of Dodge & Olcott, Inc., 180 Varick St., New York City, with appointment of Mr. Willem Lasthuysen, internationally known flavor chemist. A native of Holland, Mr. Lasthuysen began his career with a paint manufacturer in the Dutch East Indies in 1930, and between 1931 and 1947 was employed by Heine & Co., A. G., Germany, and Naarden. In the

latter year, he emigrated to this country and became a flavor chemist and plant inspector with A & P. Mr. Lasthuysen, now a U. S. citizen, is a linguist and worked for the British Intelligence Service in the Dutch underground movement during WWII. At D & O, he will work in the newly established Research and Product Development Laboratories still under construction at the Dodge & Olcott Bldg. Mr. Lasthuysen is a member of the ACS and a professional member of IFT.

LASTHUYSEN (left)
DWYER (right)

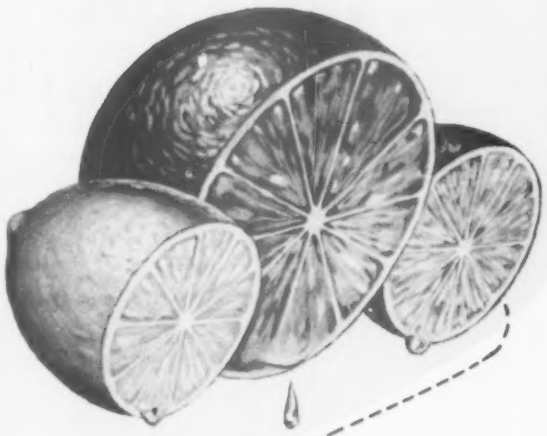
A second personnel note from D & O concerns the addition of Mr. Charles Dwyer, IFT member, to the technical staff of the Flavor Department. A graduate of Columbia University, he served in the ETO during the war, and upon returning joined the Philip Chaleyer organization as a flavor chemist—his connection for the past eight years.

• • •

Believing it "axiomatic that quality control begins in the field and with the seed," American Can Company has expanded its West Coast service of providing specific information on crop production questions with appointment of Dr. George A. Johannessen of Cornell University as agronomist for Canco's Pacific Division. Dr. Johannessen received his schooling at Rutgers University, Purdue University, and Cornell, and has been extension specialist in vegetable crops and fruit growing at the latter institution for the past three years. In his new post, he will assist individual Canco customers in efforts to solve canning crop production problems, according to Dr. F. W. Geise, manager of the Agronomy Division of the firm's Research and Technical Department. Dr. Johannessen succeeds W. C. Hatfield, recently appointed to the Canco sales staff.

The same company's Canadian Division announces appointment of Mr. G. H. McVean, manager of sales, to the newly created position of vice president in charge of Canadian operations. He succeeds Mr. Gordon Mann, who retired as general manager of the Canadian Division after 34 years of service with the company. Mr. McVean joined Canco at its Montreal factory in 1931 after graduating from the University of Toronto with a degree in mechanical engineering. He was appointed manager of sales for Canada in 1949.

Finally, from Canco, comes word that Mr. F. Joujon-Roche has been appointed to the newly created post of manager of manufacture of the company's Closing Machine Department. Creation of the new position will augment the firm's continuing policy of producing higher quality can closing equipment for sale to customers on the most economical basis, according to Mr. J. A. Stewart, vice president in charge of the Department. Mr. Joujon-Roche joined the company in 1932 as a mechanical engineer following his graduation from Stanford University.



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retard RANCIDITY!

...on High-Fat Low-Moisture Foods!

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The effectiveness, ease of use and economy of this new salt will more than justify its test in your operation. Samples are available upon request. Send for yours today!

Write to Technical Director, Diamond Crystal Salt Co., St. Clair, Michigan.

DIAMOND CRYSTAL SALT with Antioxidant

Since 1950, he has been manager of the Closing Machine Department of Canco's Pacific Division. He will be succeeded in this post by Mr. W. D. Grimmer, assistant manager.

◆ ◆ ◆

Mr. Hans Kessler, sales manager of Givaudan Flavors Inc., New York City, successfully combined business with pleasure during a recent four-week visit to Switzerland, home of L. Givaudan & Cie., S. A., the American company's European affiliate.

◆ ◆ ◆

Promotion of Dr. M. C. Brockman, formerly senior scientist in the department, to director of research of Kingan & Co., Indianapolis, has been announced by Mr. T. R. L. Sinclair, executive vice president. Dr. Brockman has a B.S. in chemistry and an M.S. in bacteriology from Iowa State University, and received his doctorate in physiology at Indiana University. His professional memberships include the IFT, AAAS, ACS, Society for Industrial Microbiology, and the Society of American Bacteriologists.

◆ ◆ ◆

Mr. Robert I. Dietrich has been appointed assistant to the sales manager of general line cans in Continental Can Company's central metal division, according to Mr. Wilson B. Larkin, division manager of sales. Before joining Continental, Mr. Dietrich was district sales manager for the midwest area of Jones & Laughlin Steel Corporation's steel pail division.

◆ ◆ ◆

A promotion and an appointment are in the news received from Putman Publishing Co., 111 E. Delaware Pl., Chicago 11, Ill. The promotion involves Mr. Chas. H. Oestmann who moves from Midwest sales supervisor of Putman publications to the position of sales manager of *Food Processing* magazine. The party of the second part is Mr. Karl Klomparens, appointed assistant editor of the same publication. Mr. Klomparens, who holds an M.S. in Food Technology from Michigan State College, has had three years of teaching experience at State University of New York, Morrisville, N. Y., and most recently gained industrial background at Swift & Company's Dairy Plant in Holland, Mich. He is a member of IFT, ACS, and Sigma Xi. Both Mr. Oestmann and Mr. Klomparens will center their activities in the Chicago area.

◆ ◆ ◆

Mr. Arlee A. Andre, who developed the commercial formulations for the Duncan Hines Cake Mixes, has been elected vice president of the Nebraska Consolidated Mills Company, Omaha, Nebraska. Mr. Andre has been with the firm for 25 years and

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will continue as director of Research and Quality Control. Nebraska Consolidated Mills manufactures and distributes the Duncan Hines mixes under license from Hines-Park Foods, Inc., Ithaca, N. Y.

◆ ◆ ◆

Succeeding Mr. Randolph Crossley, who resigned May 29, Mr. Dorsey W. Edwards has been elected president of the Hawaiian Fruit Packers, Ltd., a subsidiary of Stokely-Van Camp, Inc., located in Kapaa, Kauai, Hawaii. Mr. Edwards, who has had many years experience in the industry, was serving in the capacity of treasurer and manager of the company at the time of his appointment. He has been with the organization since 1937, when it was known as the Grower's Canning Assn. He became treasurer-manager in 1942, the year the company was re-named and re-organized as the Hawaiian Fruit Packers, Ltd. In his new capacity as president, Mr. Edwards will assume responsibility for the operation of the plantation and factory and all problems of production and shipping.

◆ ◆ ◆

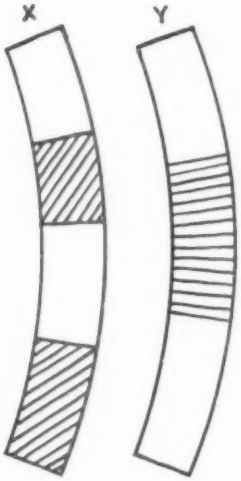
Dr. Alphons Otto Jaeger, 67, of American Cyanamid Company, died suddenly on July 21. Dr. Jaeger, born in Bergzabern, Germany, held hundreds of patents on important chemical manufacturing processes which he developed during his 40-year career in the chemical industry. Among his most important developments was a vanadium catalyst for sulfuric acid production, which has become the basis of more than 90% of the world's sulfuric acid producing facilities constructed in the past quarter century. Until Dr. Jaeger's retirement in 1951, he had been chairman of the Development Committee, director of the General Technical Department, and a member of the Research, New Projects, and Process Development Committees. Following his retirement, he had been a consultant for the company.

◆ ◆ ◆

"Man of the Year" was the honor accorded to Mr. George P. Meade by the Carbohydrate Division of the American Chemical Society at its meeting in Chicago on September 9. Mr. Meade, who has rounded out a distinguished career of more than half a century in the sugar industry, is co-author of Spencer-Meade's "Cane Sugar Handbook," the standard reference on sugar technology, manager of Colonial Sugar Company's refinery at Gramercy, La., and a director of The Cuban-American Sugar Company. At a dinner in the Palmer House, he was presented a commemorative scroll on behalf of the Carbohydrate Division by the chairman, Mr. Thos. R. Gillett of California and Hawaiian Sugar Refining Corp., Crockett, Calif., and bound volumes of the papers which he has contributed to professional and scientific publications during the last 40 years. Mr. Meade is the seventh American scientist to be chosen "Man of the Year" by the Carbohydrate Division. He has been a members of the ACS since 1907.

GEO P. MEADE

(Continued on page 49)



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FUTURE DATES FOR FOOD TECHNOLOGISTS

1953

October 12-14	Fifteenth Annual Forum of the Packaging Institute, New York City
October 12-14	Association of Official Agricultural Chemists, Washington, D. C.
October 19-23	National Safety Congress, Chicago, Illinois
October 19-23	Industrial Packaging & Materials Handling Exposition, Boston, Massachusetts
October 20-23	International Brewing Industries Exposition, St. Louis, Missouri
October 26-27	National Association of Suggestion Systems, Pittsburgh, Pennsylvania
October 26-27	National Pickle Packers Association, Annual Meeting, Chicago, Illinois
November 2-4	Fall Meeting of the American Oil Chemists Society, Chicago.
November 9-12	International Soft Drink Industry Exposition, Chicago, Illinois
November 11-13	Association of Food Industries Sanitarians, Berkeley, California
November 20	Dairy Industries Society, International, Washington, D. C.
November 23	Manufacturing Chemists Association, New York, N. Y.
December 13-16	Annual Meeting of the American Institute of Chemical Engineers, St. Louis, Missouri
December 26-31	Annual Meeting of the American Association for the Advancement of Science, Boston, Massachusetts
June 27 to July 1, 1954	**Fourteenth Annual Meeting of the Institute of Food Technologists, Los Angeles, California**

(Information concerning future dates of national and international meetings, conventions and exhibits of interest to food technologists should be sent to the editorial office.)

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FOOD INDUSTRY TOPICS

(Continued from page 47)

Dr. Gladys E. Vail, head of the department of food and nutrition at Kansas State College, comes to Purdue University September 1 in the same capacity, according to an announcement by Dr. Beulah V. Gillespie, dean of the School of Home Economics. Dr. Vail will hold the rank of professor, and plans are being made for expanding the graduate and research opportunities in the Food and Nutrition Department under her direction. Prof. Amy Bloye, long-time staff member, will give up her administrative duties as head of the department, and will continue as professor on the staff. At Kansas State College since 1927, Dr. Vail became head of the Food Economics and Nutrition Department there in 1946. She was in charge of home economics research at the Kansas Agricultural Experiment Station, in addition to teaching and directing research projects in the department, and received the Christie Award for work on poultry products in 1950.

◆ ◆ ◆

Mr. Arlee A. Andre, who developed the commercial formulations for the Duncan Hines Cake Mixes, has been elected vice president of the Nebraska Consolidated Mills Company, Omaha, Nebraska. Mr. Andre has been with the firm for 25 years and will continue as director of Research and Qualiyt Control. Nebraska Consolidated Mills manufactures and distributes the Duncan Hines mixes under license from Hines-Park Foods, Inc., Ithaca, N. Y.

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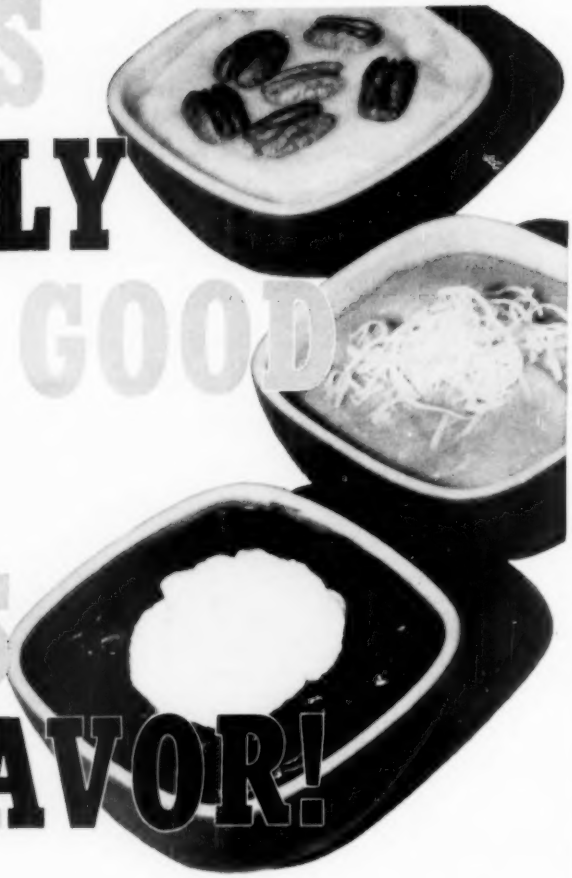

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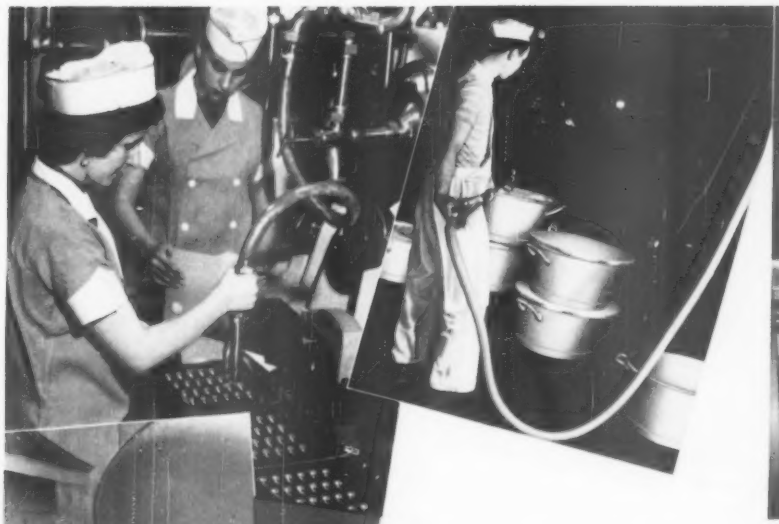

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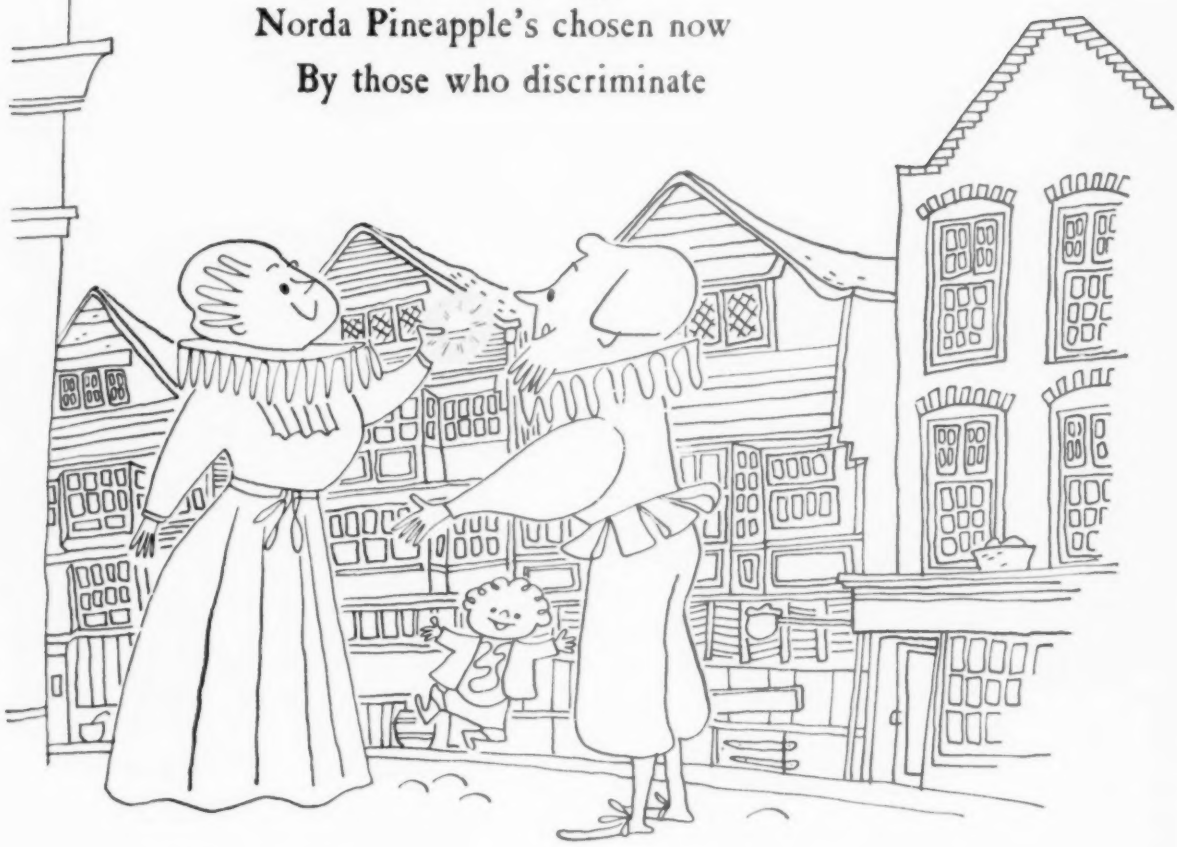

Norda Pineapple Flavor is a favorite where quality counts. It meets Norda's strict flavor standards. It is made fine, to give fine results.

Test it by the most stringent tests, and decide for yourself its merits. See if you don't find—in both genuine and imitation Norda Pineapple—a remarkable re-creation of fresh fruit, true pineapple richness—the real character of the real fruit. All Norda Flavors taste natural.

The concentrated strength of Norda Pineapple Flavor makes it economical to use. Send for a generous sample. Let Norda start helping you to better products and greater profits.

Use "A Favorite to Flavor It"... A Norda Flavor

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